SMC Template Class 1.0

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Contents

Chapter 1

smctc – A Template Class Library for SMC Simulation

Version:

1.0

Author:

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1.1 Summary

The SMC template class library (SMCTC) is intended to be used to implement SMC algorithms ranging from simple particle filter to complicated SMC algorithms from simple particle filters to the SMC samplers of Del Moral, Doucet and Jasra (2006) within a generic framework.

1.2 License

The software is still in development but is thought to be sufficiently fully-featured and stable for use.

1.3 Using the Template Library

In order to use the template libary it is necessary to place the set of header files in a suitable include directory and then to instantiate the various classes with the appropriate type for your sampler.

For implementation details, please see the accompanying user guide.

1.4 Examples

1.4.1 Simple Particle Filter

This example provides a simple particle filter for the approximate filtering of nonlinear, nongaussian state space models.

1.4.2 Samplers for Rare Event Simulation

The main.cc file provides an example of a use of the template library to estimate Gaussian tail probabilities within an SMC samplers framework by making use of a sequence of intermediate distributions defined by introducing a potential function which varies from flat to being very close to an indicator function on the tail event.

This example is taken from from Johansen, Del Moral and Doucet (2006).

1.4.3 Acknowledgements

Thanks are due to Edmund Jackson and Mark Briers for testing SMCTC on a variety of platforms. The Visual C++ project and solution files are kindly provided by Mark Briers.

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Namespace Index

2.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 3

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3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

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File Index

4.1 File List

Here is a list of all files with brief descriptions:

Chapter 5

Namespace Documentation

5.1 smc Namespace Reference

The Sequential Monte Carlo namespace.

Classes

- class historyflags

  The historyflags class holds a set of flags which describe various properties of the particle system at a given time.

- class historyelement

  A template class for the elements of a linked list to be used for the history of the sampler.

- class history

  A template class for the history associated with a particle system evolving in SMC.

- class moveset

  A template class for a set of moves for use in an SMC samplers framework.

- class particle

  A template class for the particles of an SMC algorithm.

- class gslrnginfo

  A gsl-rng information handling class (not templated).

- class rng

  A random number generator class.

- class sampler

  A template class for an interacting particle system suitable for SMC sampling.

- class exception

  SMC Exception class.

Variables

- gslrnginfo rngset

  The global application instance of the gslrnginfo class:.

5.1.1 Detailed Description

The Sequential Monte Carlo namespace.

The classes and functions within this namespace are intended to be used for producing implemenetations of SMC samplers and related simulation techniques.

5.1.2 Variable Documentation

5.1.2.1 gslrnginfo smc::rngset

The global application instance of the gslrnginfo class:.

5.2 std Namespace Reference

The standard namespace.

Functions

- template<class Particle>
  ostream & operator<< (ostream &os, smc::history< Particle > h)

  This function will ultimately allow the standard stream operators to be used to display a particle history in a human readable form.

- template<class Space>
  std::ostream & operator<< (std::ostream &os, smc::particle< Space > &p)

  Produce a human readable display of an smc::particle class using the standard stream operators.

- template<class Space>
  std::ostream & operator<< (std::ostream &os, smc::sampler< Space > &s)

  Produce a human-readable display of the state of an smc::sampler class using the stream operator.

- std::ostream & operator<< (std::ostream &, smc::exception &)

  Produce a human-readable display of the state of an smc::exception class using the stream operator.

5.2.1 Detailed Description

The standard namespace.

The classes provided within the standard libraries reside within this namespace and the TDSMC class library adds a number of additional operator overloads to some of the standard classes to allow them to deal with our structures.

5.2.2 Function Documentation

5.2.2.1 std::ostream & std::operator<< (std::ostream & *os*, smc::exception & *e*)

Produce a human-readable display of the state of an smc::exception class using the stream operator.

Display a human-readable version of an SMC exception.

Produce a human-readable display of the state of an smc::exception class using the stream operator.

Parameters:

os The output stream to which the display should be made.

e The exception which is to be displayed.

os The stream to write to.

e The exception class to display.

Returns:

os

Definition at line 32 of file smc-exception.cc.

References smc::exception::lCode, smc::exception::lLine, smc::exception::szFile, and smc::exception::szMessage.

5.2.2.2 template<class Space> std::ostream& std::operator<< (std::ostream & *os*, smc::sampler< Space > & *s*) [inline]

Produce a human-readable display of the state of an smc::sampler class using the stream operator.

Parameters:

os The output stream to which the display should be made.

s The sampler which is to be displayed.

Definition at line 546 of file sampler.hh.

5.2.2.3 template<class Space> std::ostream& std::operator<< (std::ostream & *os*, smc::particle< Space > & *p*) [inline]

Produce a human readable display of an smc::particle class using the standard stream operators.

Parameters:

os The output stream to which the display should be made.

p The particle which is to be displayed.

Definition at line 141 of file particle.hh.

5.2.2.4 template<class Particle> ostream& std::operator<< (ostream & *os*, smc::history< Particle > *h*) [inline]

This function will ultimately allow the standard stream operators to be used to display a particle history in a human readable form.

It isn't yet fully implemented.

Definition at line 460 of file history.hh.

Chapter 6

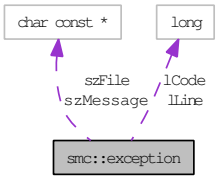
Class Documentation

6.1 smc::exception Class Reference

SMC Exception class.

`#include <smc-exception.hh>`

Collaboration diagram for smc::exception:



Public Member Functions

- exception (char const ∗, long, long, char const ∗)

  Generate an SMCTC Exception class with the specified initialisation.

Public Attributes

- char const ∗ szFile

  The source file from which the code generating the exception was generated.

- long lLine

  The line of that source file which generates the exception.

- long lCode

  A numerical code indicating the nature of the exception generated.

- char const ∗ szMessage

  A human-readable explanation of the cause of the exception.

6.1.1 Detailed Description

SMC Exception class.

This class holds details of unrecoverable errors which occur within the SMCTC library. An instance of it is thrown whenever such an error occurs.

Definition at line 45 of file smc-exception.hh.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 smc::exception::exception (char const * *szN*, long *lL*, long *lC*, char const * *szM*)

Generate an SMCTC Exception class with the specified initialisation.

This constructor fills the four elements of the class with their specified values. It is used to allow a single-line command to create and throw an exception.

Parameters:

szN The name of the source file generating the exception.

lL The line in that file responsible for the exception.

lC The numerical code identifying the exception.

szM An textual explanation of the problem.

Definition at line 17 of file smc-exception.cc.

References lCode, lLine, szFile, and szMessage.

6.1.3 Member Data Documentation

6.1.3.1 char const* smc::exception::szFile

The source file from which the code generating the exception was generated.

Definition at line 47 of file smc-exception.hh.

Referenced by exception(), and std::operator<<().

6.1.3.2 long smc::exception::lLine

The line of that source file which generates the exception.

Definition at line 48 of file smc-exception.hh.

Referenced by exception(), and std::operator<<().

6.1.3.3 long smc::exception::lCode

A numerical code indicating the nature of the exception generated.

Definition at line 49 of file smc-exception.hh.

Referenced by exception(), and std::operator<<().

6.1.3.4 char const* smc::exception::szMessage

A human-readable explanation of the cause of the exception.

Definition at line 50 of file smc-exception.hh.

Referenced by exception(), and std::operator<<().

The documentation for this class was generated from the following files:

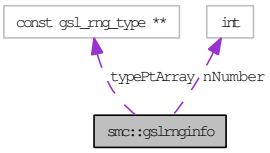
- include/smc-exception.hh
- src/smc-exception.cc

6.2 smc::gslrnginfo Class Reference

A gsl-rng information handling class (not templated).

`#include <rng.hh>`

Collaboration diagram for smc::gslrnginfo:



Public Member Functions

- int GetNumber ()

  Returns the number of available random number generators.

- const char * GetNameByIndex (int nIndex)

  Returns the name of random number generator number nIndex.

- const gsl_rng_type * GetPointerByIndex (int nIndex)

  Returns a pointer to random number generator nIndex.

- const gsl_rng_type * GetPointerByName (const char *szName)

  Returns a pointer to the random number generator with name szName (or null if it doesn't exist).

Static Public Member Functions

- static gslrnginfo * GetInstance ()

  Returns a reference to the sole static instance of this class.

Protected Member Functions

- gslrnginfo ()

Private Attributes

- const gsl_rng_type ** typePtArray

  This is a null terminated array of the available random number generators.

- int nNumber

  The number of available random number generators.

6.2.1 Detailed Description

A gsl-rng information handling class (not templated).

Definition at line 37 of file rng.hh.

6.2.2 Constructor & Destructor Documentation

6.2.2.1 smc::gslrnginfo::gslrnginfo () [protected]

The GSL provides a mechanism for obtaining a list of available random number generators.

This class provides a wrapper for this mechanism and makes it simple to implement software which allows the nature of the random number generator to be specified at runtime (and to allow it to be a user-specifiable parameter).

For example, gslrnginfo::GetNumber can be used to determine how many RNGs are available and gslrnginfo::GetNameByIndex can then be used to populate a list box with their names. Once the user has selected on the gslrnginfo::GetPointerByName function can be used to obtain a pointer to the appropriate type and this can be used to produce a random number generator of the desired type.

There should be exactly one instance of this class in any program, and that instance is created by the library. A singleton DP implementation ensures that any additional attempt to instatiate the class simply returns a reference to the existing instance.

Definition at line 26 of file rng.cc.

References nNumber, and typePtArray.

6.2.3 Member Function Documentation

6.2.3.1 gslrnginfo * smc::gslrnginfo::GetInstance () [static]

Returns a reference to the sole static instance of this class.

Returns a pointer to a single instance of this class.

Definition at line 40 of file rng.cc.

6.2.3.2 int smc::gslrnginfo::GetNumber (void)

Returns the number of available random number generators.

This function returns the number of available generators.

Definition at line 48 of file rng.cc.

References nNumber.

6.2.3.3 const char * smc::gslrnginfo::GetNameByIndex (int *nIndex*)

Returns the name of random number generator number nIndex.

This function returns the name of the specified generator.

Definition at line 54 of file rng.cc.

References nNumber, and typePtArray.

6.2.3.4 const gsl_rng_type * smc::gslrnginfo::GetPointerByIndex (int *nIndex*)

Returns a pointer to random number generator nIndex.

This function returns a pointer to the specified generator type.

Definition at line 62 of file rng.cc.

References nNumber, and typePtArray.

6.2.3.5 const gsl_rng_type * smc::gslrnginfo::GetPointerByName (const char * *szName*)

Returns a pointer to the random number generator with name szName (or null if it doesn't exist).

This function returns a pointer to the specified generator type.

Definition at line 70 of file rng.cc.

References nNumber, and typePtArray.

6.2.4 Member Data Documentation

6.2.4.1 const gsl_rng_type** smc::gslrnginfo::typePtArray [private]

This is a null terminated array of the available random number generators.

Definition at line 40 of file rng.hh.

Referenced by GetNameByIndex(), GetPointerByIndex(), GetPointerByName(), and gslrnginfo().

6.2.4.2 int smc::gslrnginfo::nNumber [private]

The number of available random number generators.

Definition at line 42 of file rng.hh.

Referenced by GetNameByIndex(), GetNumber(), GetPointerByIndex(), GetPointerByName(), and gslrnginfo().

The documentation for this class was generated from the following files:

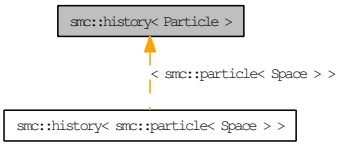
- include/rng.hh
- src/rng.cc

6.3 smc::history< Particle > Class Template Reference

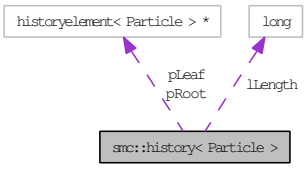
A template class for the history associated with a particle system evolving in SMC.

`#include <history.hh>`

Inheritance diagram for smc::history< Particle >:



Collaboration diagram for smc::history< Particle >:



Public Member Functions

- history ()

  The argument free constructor creates an empty list.

- const historyelement< Particle > * GetElement (void) const

  This function returns a pointer to the first element of the history.

- double GetESS (long lGeneration) const

  Returns the effective sample size of the specified particle generation.

- long GetLength (void) const

  Returns the number of generations recorded within the history.

- double IntegratePathSampling (double(*pIntegrand)(long, const Particle &, void *), double(*pWidth)(long, void *), void *pAuxiliary)

  Integrate the supplied function over the path of the particle ensemble.

- double IntegratePathSamplingFinalStep (double(*pIntegrand)(long, const Particle &, void *), void *pAuxiliary) const
- void OstreamMCMCRecordToStream (std::ostream &os) const

  Output a vector indicating the number of accepted MCMC moves at each time instance.

- void OstreamResamplingRecordToStream (std::ostream &os) const

  Output a 0-1 value vector indicating the times at which resampling occured to an output stream.

- Particle * Pop (void)

Remove the terminal particle generation from the list and return that particle.

- void Pop (long *plNumber, Particle **ppNew, int *pnAccept, historyflags *phf)
  Remove the terminal particle generation from the list and stick it in the supplied data structures.
- void Push (long lNumber, Particle *pNew, int nAccept, historyflags hf)
  Append the supplied particle generation to the end of the list.

Private Attributes

- long lLength
  The length of the history in time steps.
- historyelement< Particle > * pRoot
  The first time step.
- historyelement< Particle > * pLeaf
  The most recent time step.

6.3.1 Detailed Description

template<class Particle> class smc::history< Particle >

A template class for the history associated with a particle system evolving in SMC.

The history is a template class which should have an associated class type corresponding to a _particle_ of the desired type, not the type itself.

Essentially, this is implemented as a doubly linked list.

Definition at line 232 of file history.hh.

6.3.2 Constructor & Destructor Documentation

6.3.2.1 template<class Particle> smc::history< Particle >::history () [inline]

The argument free constructor creates an empty list.

This constructor simply sets the root and leaf pointers to NULL and the list length to zero.

Definition at line 276 of file history.hh.

References smc::history< Particle >::lLength, smc::history< Particle >::pLeaf, and smc::history< Particle >::pRoot.

6.3.3 Member Function Documentation

6.3.3.1 template<class Particle> const historyelement<Particle >* smc::history< Particle >::GetElement (void) const [inline]

This function returns a pointer to the first element of the history.

Definition at line 247 of file history.hh.

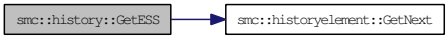
6.3.3.2 template<class Particle> double smc::history< Particle >::GetESS (long *lGeneration*) const [inline]

Returns the effective sample size of the specified particle generation.

Definition at line 284 of file history.hh.

References smc::historyelement< Particle >::GetNext(), and smc::history< Particle >::pRoot.

Here is the call graph for this function:



6.3.3.3 template<class Particle> long smc::history< Particle >::GetLength (void) const [inline]

Returns the number of generations recorded within the history.

Definition at line 252 of file history.hh.

6.3.3.4 template<class Particle> double smc::history< Particle >::IntegratePathSampling (double(*)(long, const Particle &, void *) *pIntegrand*, double(*)(long, void *) *pWidth*, void * *pAuxiliary*) [inline]

Integrate the supplied function over the path of the particle ensemble.

This function performs a trapezoidal integration of the type which is useful when using path sampling to estimate the normalising constant of a potential function in those cases where a sequence of distributions is produced by deforming the initial distribution by a sequence of progressively more influential potential functions which are proportional to the density of some other distribution with respect to the starting distribution.

The integrand is integrated at every time point in the particle system history. The results of this integration are taken to be point-evaluations of the path sampling integrand which are spaced on a grid of intervals given by the width function. The path sampling integral is then calculated by performing a suitable trapezoidal integration and the results of this integration is returned.

pAuxiliary is passed to both of the user specified functions to allow the user to pass additional data to either or both of these functions in a convenient manner. It is safe to use NULL if no such data is used by either function.

Parameters:

pIntegrand The function to integrated. The first argument is evolution time, the second a particle at which the function is to be evaluated and the final argument is always pAuxiliary.

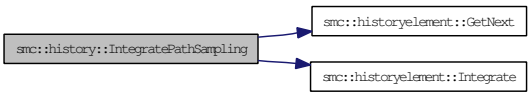
pWidth The function which returns the width of the path sampling grid at the specified evolution time. The final argument is always pAuxiliary

pAuxiliary A pointer to auxiliary data to pass to both of the above functions

Definition at line 347 of file history.hh.

References smc::historyelement< Particle >::GetNext(), smc::historyelement< Particle >::Integrate(), and smc::history< Particle >::pRoot.

Here is the call graph for this function:



6.3.3.5 template<class Particle> double smc::history< Particle >::IntegratePathSamplingFinalStep (double(*)(long, const Particle &, void *) *pIntegrand*, void * *pAuxiliary*) const [inline]

Definition at line 366 of file history.hh.

References smc::history< Particle >::lLength, and smc::history< Particle >::pLeaf.

6.3.3.6 template<class Particle> void smc::history< Particle >::OstreamMCMCRecordToStream (std::ostream & *os*) const [inline]

Output a vector indicating the number of accepted MCMC moves at each time instance.

This function records the MCMC acceptance history to the specified output stream as a list of the number of moves accepted at each time instant.

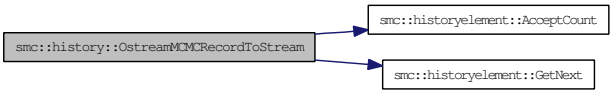
Parameters:

os The output stream to send the data to.

Definition at line 299 of file history.hh.

References smc::historyelement< Particle >::AcceptCount(), smc::historyelement< Particle >::GetNext(), and smc::history< Particle >::pRoot.

Here is the call graph for this function:



6.3.3.7 template<class Particle> void smc::history< Particle >::OstreamResamplingRecordToStream (std::ostream & *os*) const [inline]

Output a 0-1 value vector indicating the times at which resampling occured to an output stream.

This function records the resampling history to the specified output stream as a 0-1 valued list which takes the value 1 for those time instances when resampling occured and 0 otherwise.

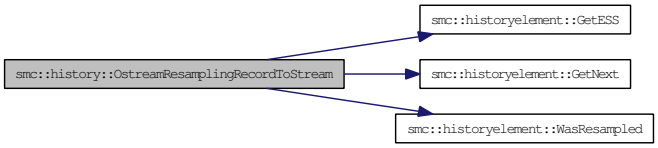
Parameters:

os The output stream to send the data to.

Definition at line 313 of file history.hh.

References smc::historyelement< Particle >::GetESS(), smc::historyelement< Particle >::GetNext(), smc::history< Particle >::pRoot, and smc::historyelement< Particle >::WasResampled().

Here is the call graph for this function:



6.3.3.8 template<class Particle> Particle * smc::history< Particle >::Pop (void) [inline]

Remove the terminal particle generation from the list and return that particle.

Pop() operates just as the standard stack operation does. It removes the particle generation currently occupying the terminal position in the chain, decrements the length counter and returns the particle set as an array.

Definition at line 375 of file history.hh.

References smc::history< Particle >::lLength, smc::history< Particle >::pLeaf, and smc::history< Particle >::pRoot.

6.3.3.9 template<class Particle> void smc::history< Particle >::Pop (long * *plNumber*, Particle ** *ppNew*, int * *pnAccept*, historyflags * *phf*) [inline]

Remove the terminal particle generation from the list and stick it in the supplied data structures.

Pop operates as the usual stack operation

If called with four pointers of this sort, it removes the last particle generation from the history stack and places them in the reference objects.

Definition at line 400 of file history.hh.

References smc::history< Particle >::lLength, smc::history< Particle >::pLeaf, and smc::history< Particle >::pRoot.

6.3.3.10 template<class Particle> void smc::history< Particle >::Push (long *lNumber*, Particle * *pNew*, int *nAccepts*, historyflags *hf*) [inline]

Append the supplied particle generation to the end of the list.

Push operates just like the standard stack operation: it adds the specified particle set generation to the history of the particle set and increments the stack counter.

Parameters:

lNumber The number of particles present in this generation of the system.

pNew An array containing the particles present in this generation of the system.

nAccepts The number of accepted MCMC moves during this iteration of the system

hf The historyflags associated with this generation of the system.

Definition at line 439 of file history.hh.

References smc::historyelement< Particle >::GetLast(), smc::history< Particle >::lLength, smc::history< Particle >::pLeaf, and smc::history< Particle >::pRoot.

Here is the call graph for this function:

6.3.4 Member Data Documentation

6.3.4.1 template<class Particle> long smc::history< Particle >::lLength [private]

The length of the history in time steps.

Definition at line 236 of file history.hh.

Referenced by smc::history< Particle >::history(), smc::history< Particle >::IntegratePathSamplingFinalStep(), smc::history< Particle >::Pop(), and smc::history< Particle >::Push().

6.3.4.2 template<class Particle> historyelement<Particle>* smc::history< Particle >::pRoot [private]

The first time step.

Definition at line 238 of file history.hh.

Referenced by smc::history< Particle >::GetESS(), smc::history< Particle >::history(), smc::history< Particle >::IntegratePathSampling(), smc::history< Particle >::OstreamMCMCRecordToStream(), smc::history< Particle >::OstreamResamplingRecordToStream(), smc::history< Particle >::Pop(), and smc::history< Particle >::Push().

6.3.4.3 template<class Particle> historyelement<Particle>* smc::history< Particle >::pLeaf [private]

The most recent time step.

Definition at line 240 of file history.hh.

Referenced by smc::history< Particle >::history(), smc::history< Particle >::IntegratePathSamplingFinalStep(), smc::history< Particle >::Pop(), and smc::history< Particle >::Push().

The documentation for this class was generated from the following file:

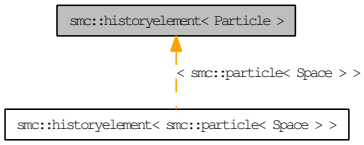
- include/history.hh

6.4 smc::historyelement< Particle > Class Template Reference

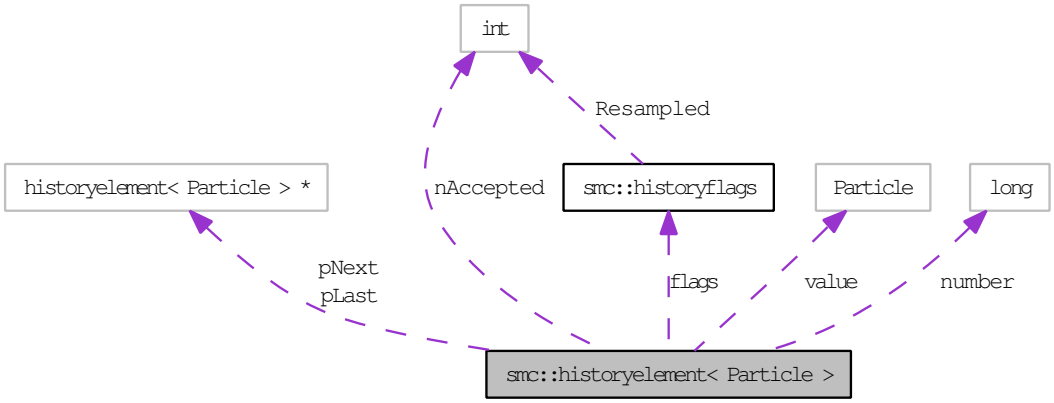
A template class for the elements of a linked list to be used for the history of the sampler.

`#include <history.hh>`

Inheritance diagram for smc::historyelement< Particle >:



Collaboration diagram for smc::historyelement< Particle >:



Public Member Functions

- historyelement ()

  The null constructor creates an empty history element.

- historyelement (long lNumber, Particle *pNew, int nAccepts, historyflags hf)

  A constructor with four arguments initialises the particle set.

- historyelement (long lNumber, Particle *pNew, historyelement< Particle > *pParent, historyelement< Particle > *pChild, int nAccepts, historyflags hf)

  A constructor with six arguments initialises the whole structure.

- ~historyelement ()

  The destructor tidies up.

- double GetESS (void) const

  Returns the effective sample size of this particle generation.

- historyflags GetFlags (void) const

  Returns the flags.

- historyelement< Particle > * GetLast (void) const

  Returns the parent of this element.

- historyelement< Particle > * GetNext (void) const

  Returns the child of this element.

- long GetNumber (void) const

  Returns the number of particles present.

- Particle * GetValues (void) const

  Returns a pointer to the current particle set.

- void InsertAfter (long lNumber, Particle *pNew)

  Add a new history element with the specified values after the current one and maintain the list structure.

- long double Integrate (long lTime, double(*pIntegrand)(long, const Particle &, void *), void *pAuxiliary)

  Integrate the supplied function according to the empirical measure of the particle ensemble.

- void SetLast (historyelement< Particle > *pParent)

  Sets the elements parent.

- void SetNext (historyelement< Particle > *pChild)

  Sets the elements child.

- void SetValue (long lNumber, Particle *pNew)

  Sets the particle set to the specified values.

- int AcceptCount (void)

  Returns the number of MCMC moves accepted during this iteration.

- int WasResampled (void)

  Returns true if the particle set.

- historyelement< Particle > operator<< (unsigned long ulCount)

  The left shift operator returns the element a number of positions prior to this one.

- historyelement< Particle > operator>> (unsigned long ulCount)

  The right shift operator returns the element a number of positions after this one.

Private Attributes

- long number

  The number of particles (presently redundant as this is not a function of iteration).

- int nAccepted

  Number of MCMC moves accepted during this iteration.

- Particle * value

  The particles themselves (values and weights).

- historyflags flags

  Flags associated with this iteration.

- historyelement< Particle > * pLast

  The parent of this node.

- historyelement< Particle > * pNext

  The child of this node.

6.4.1 Detailed Description

template<class Particle> class smc::historyelement< Particle >

A template class for the elements of a linked list to be used for the history of the sampler.

Definition at line 46 of file history.hh.

6.4.2 Constructor & Destructor Documentation

6.4.2.1 template<class Particle> smc::historyelement< Particle >::historyelement () [inline]

The null constructor creates an empty history element.

Definition at line 122 of file history.hh.

References smc::historyelement< Particle >::nAccepted, smc::historyelement< Particle >::number, smc::historyelement< Particle >::pLast, smc::historyelement< Particle >::pNext, and smc::historyelement< Particle >::value.

6.4.2.2 template<class Particle> smc::historyelement< Particle >::historyelement (long *lNumber*, Particle * *pNew*, int *nAccepts*, historyflags *hf*) [inline]

A constructor with four arguments initialises the particle set.

Parameters:

lNumber The number of particles present in the particle generation

pNew The array of particles which are present in the particle generation

nAccepts The number of MCMC moves that were accepted during this particle generation

hf The historyflags associated with the particle generation

Definition at line 138 of file history.hh.

References smc::historyelement< Particle >::nAccepted, smc::historyelement< Particle >::number, smc::historyelement< Particle >::pLast, smc::historyelement< Particle >::pNext, and smc::historyelement< Particle >::value.

6.4.2.3 template<class Particle> smc::historyelement< Particle >::historyelement (long *lNumber*, Particle * *pNew*, historyelement< Particle > * *pParent*, historyelement< Particle > * *pChild*, int *nAccepts*, historyflags *hf*) [inline]

A constructor with six arguments initialises the whole structure.

Parameters:

lNumber The number of particles present in the particle generation

pNew The array of particles which are present in the particle generation

pParent A pointer to the previous particle generation

pChild A pointer to the next particle generation

nAccepts The number of MCMC moves that were accepted during this particle generation

hf The historyflags associated with the particle generation

Definition at line 158 of file history.hh.

References smc::historyelement< Particle >::nAccepted, smc::historyelement< Particle >::number, smc::historyelement< Particle >::pLast, smc::historyelement< Particle >::pNext, and smc::historyelement< Particle >::value.

6.4.2.4 template<class Particle> smc::historyelement< Particle >::~historyelement (void) [inline]

The destructor tidies up.

Definition at line 174 of file history.hh.

References smc::historyelement< Particle >::value.

6.4.3 Member Function Documentation

6.4.3.1 template<class Particle> double smc::historyelement< Particle >::GetESS (void) const [inline]

Returns the effective sample size of this particle generation.

Definition at line 181 of file history.hh.

References smc::historyelement< Particle >::number, and smc::historyelement< Particle >::value.

Referenced by smc::history< Particle >::OstreamResamplingRecordToStream().

6.4.3.2 template<class Particle> historyflags smc::historyelement< Particle >::GetFlags (void) const [inline]

Returns the flags.

Definition at line 70 of file history.hh.

6.4.3.3 template<class Particle> historyelement<Particle>* smc::historyelement< Particle >::GetLast (void) const [inline]

Returns the parent of this element.

Definition at line 72 of file history.hh.

Referenced by smc::history< Particle >::Push().

6.4.3.4 template<class Particle> historyelement<Particle>* smc::historyelement< Particle >::GetNext (void) const [inline]

Returns the child of this element.

Definition at line 74 of file history.hh.

Referenced by smc::history< Particle >::GetESS(), smc::history< Particle >::IntegratePathSampling(), smc::history< Particle >::OstreamMCMCRecordToStream(), and smc::history< Particle >::OstreamResamplingRecordToStream().

6.4.3.5 template<class Particle> long smc::historyelement< Particle >::GetNumber (void) const [inline]

Returns the number of particles present.

Definition at line 76 of file history.hh.

6.4.3.6 template<class Particle> Particle* smc::historyelement< Particle >::GetValues (void) const [inline]

Returns a pointer to the current particle set.

Definition at line 78 of file history.hh.

6.4.3.7 template<class Particle> void smc::historyelement< Particle >::InsertAfter (long *lNumber*, Particle * *pNew*) [inline]

Add a new history element with the specified values after the current one and maintain the list structure.

Parameters:

lNumber The number of particles in the generation to be inserted

pNew The value of the particle generation to be inserted

Definition at line 219 of file history.hh.

References smc::historyelement< Particle >::pNext.

6.4.3.8 template<class Particle> long double smc::historyelement< Particle >::Integrate (long *lTime*, double(*)(long, const Particle &, void *) *pIntegrand*, void * *pAuxiliary*) [inline]

Integrate the supplied function according to the empirical measure of the particle ensemble.

Parameters:

lTime The timestep at which the integration is to be carried out

pIntegrand The function which is to be integrated

pAuxiliary A pointer to additional information which is passed to the integrand function

Definition at line 198 of file history.hh.

References smc::historyelement< Particle >::number, and smc::historyelement< Particle >::value.

Referenced by smc::history< Particle >::IntegratePathSampling().

6.4.3.9 template<class Particle> void smc::historyelement< Particle >::SetLast (historyelement< Particle > * *pParent*) [inline]

Sets the elements parent.

Definition at line 84 of file history.hh.

6.4.3.10 template<class Particle> void smc::historyelement< Particle >::SetNext (historyelement< Particle > * *pChild*) [inline]

Sets the elements child.

Definition at line 86 of file history.hh.

6.4.3.11 template<class Particle> void smc::historyelement< Particle >::SetValue (long *lNumber*, Particle * *pNew*)

Sets the particle set to the specified values.

6.4.3.12 template<class Particle> int smc::historyelement< Particle >::AcceptCount (void) [inline]

Returns the number of MCMC moves accepted during this iteration.

Definition at line 91 of file history.hh.

Referenced by smc::history< Particle >::OstreamMCMCRecordToStream().

6.4.3.13 template<class Particle> int smc::historyelement< Particle >::WasResampled (void) [inline]

Returns true if the particle set.

Definition at line 93 of file history.hh.

Referenced by smc::history< Particle >::OstreamResamplingRecordToStream().

6.4.3.14 template<class Particle> historyelement<Particle> smc::historyelement< Particle >::operator<< (unsigned long *ulCount*) [inline]

The left shift operator returns the element a number of positions prior to this one.

Parameters:

ulCount The number of positions by which to shift.

Returns:

The element a number of positions before this one.

Definition at line 99 of file history.hh.

6.4.3.15 template<class Particle> historyelement<Particle> smc::historyelement< Particle >::operator>> (unsigned long *ulCount*) [inline]

The right shift operator returns the element a number of positions after this one.

Parameters:

ulCount The number of positions by which to shift.

Returns:

The right shift operator returns the element a number of positions after this one.

Definition at line 111 of file history.hh.

6.4.4 Member Data Documentation

6.4.4.1 template<class Particle> long smc::historyelement< Particle >::number [private]

The number of particles (presently redundant as this is not a function of iteration).

Definition at line 49 of file history.hh.

Referenced by smc::historyelement< Particle >::GetESS(), smc::historyelement< smc::particle< Space > >::GetNumber(), smc::historyelement< Particle >::historyelement(), and smc::historyelement< Particle >::Integrate().

6.4.4.2 template<class Particle> int smc::historyelement< Particle >::nAccepted [private]

Number of MCMC moves accepted during this iteration.

Definition at line 50 of file history.hh.

Referenced by smc::historyelement< smc::particle< Space > >::AcceptCount(), and smc::historyelement< Particle >::historyelement().

6.4.4.3 template<class Particle> Particle* smc::historyelement< Particle >::value [private]

The particles themselves (values and weights).

Definition at line 51 of file history.hh.

Referenced by smc::historyelement< Particle >::GetESS(), smc::historyelement< smc::particle< Space > >::GetValues(), smc::historyelement< Particle >::historyelement(), smc::historyelement< Particle >::Integrate(), and smc::historyelement< Particle >::~historyelement().

6.4.4.4 template<class Particle> historyflags smc::historyelement< Particle >::flags [private]

Flags associated with this iteration.

Definition at line 52 of file history.hh.

Referenced by smc::historyelement< smc::particle< Space > >::GetFlags(), and smc::historyelement< smc::particle< Space > >::WasResampled().

6.4.4.5 template<class Particle> historyelement<Particle>* smc::historyelement< Particle >::pLast [private]

The parent of this node.

Definition at line 53 of file history.hh.

Referenced by smc::historyelement< smc::particle< Space > >::GetLast(), smc::historyelement< Particle >::historyelement(), smc::historyelement< smc::particle< Space > >::operator<<(), and smc::historyelement< smc::particle< Space > >::SetLast().

6.4.4.6 template<class Particle> historyelement<Particle>* smc::historyelement< Particle >::pNext [private]

The child of this node.

Definition at line 54 of file history.hh.

Referenced by smc::historyelement< smc::particle< Space > >::GetNext(), smc::historyelement< Particle >::historyelement(), smc::historyelement< Particle >::InsertAfter(), smc::historyelement< smc::particle< Space > >::operator>>(), and smc::historyelement< smc::particle< Space > >::SetNext().

The documentation for this class was generated from the following file:

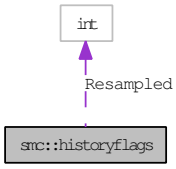
- include/history.hh

6.5 smc::historyflags Class Reference

The historyflags class holds a set of flags which describe various properties of the particle system at a given time.

`#include <history.hh>`

Collaboration diagram for smc::historyflags:



Public Member Functions

- historyflags (int wasResampled)

  Create a new set of history flags corresponding to the specified properties.

- int WasResampled (void)

  This function returns true if the flag set indicates that the ensemble was resampled during the described iteration.

Private Attributes

- unsigned int Resampled: 1

  true if the particle system was resampled during the described iteration.

6.5.1 Detailed Description

The historyflags class holds a set of flags which describe various properties of the particle system at a given time.

Definition at line 32 of file history.hh.

6.5.2 Constructor & Destructor Documentation

6.5.2.1 smc::historyflags::historyflags (int *wasResampled*)

Create a new set of history flags corresponding to the specified properties.

This constructor produces an initialised historyflags instance.

Parameters:

wasResampled An indicator which should be nonzero if the particle system was resampled during the iteration being described

Definition at line 12 of file history.cc.

References Resampled.

6.5.3 Member Function Documentation

6.5.3.1 int smc::historyflags::WasResampled (void) [inline]

This function returns true if the flag set indicates that the ensemble was resampled during the described iteration.

Definition at line 42 of file history.hh.

References Resampled.

Referenced by smc::historyelement< smc::particle< Space > >::WasResampled().

6.5.4 Member Data Documentation

6.5.4.1 unsigned int smc::historyflags::Resampled [private]

true if the particle system was resampled during the described iteration.

Definition at line 36 of file history.hh.

Referenced by historyflags(), and WasResampled().

The documentation for this class was generated from the following files:

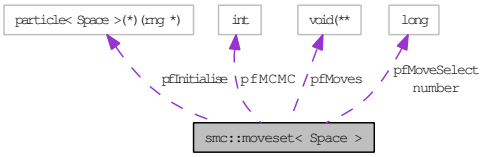
- include/history.hh
- src/history.cc

6.6 smc::moveset< Space > Class Template Reference

A template class for a set of moves for use in an SMC samplers framework.

`#include <moveset.hh>`

Collaboration diagram for smc::moveset< Space >:



Public Member Functions

- moveset ()

  Create a completely unspecified moveset.

- moveset (particle< Space >(*pfInit)(rng *), void(*pfNewMoves)(long, particle< Space > &, rng *), int(*pfNewMCMC)(long, particle< Space > &, rng *))

  Create a reduced moveset with a single move.

- moveset (particle< Space >(*pfInit)(rng *), long(*pfMoveSelector)(long, const particle< Space > &, rng *), long nMoves, void(**pfNewMoves)(long, particle< Space > &, rng *), int(*pfNewMCMC)(long, particle< Space > &, rng *))

  Create a fully specified moveset.

- particle< Space > DoInit (rng *pRng)

  Initialise a particle.

- int DoMCMC (long lTime, particle< Space > &pFrom, rng *pRng)

  Perform an MCMC move on a particle.

- void DoMove (long lTime, particle< Space > &pFrom, rng *pRng)

  Select an appropriate move at time lTime and apply it to pFrom.

- ~moveset ()

  Free the memory used for the array of move pointers when deleting.

- void SetInitialisor (particle< Space >(*pfInit)(rng *))

  Set the initialisation function.

- void SetMCMCFunction (int(*pfNewMCMC)(long, particle< Space > &, rng *))

  Set the MCMC function.

- void SetMoveSelectionFunction (long(*pfMoveSelectNew)(long, const particle< Space > &, rng *))

  Set the move selection function.

- void SetMoveFunctions (long nMoves, void(**pfNewMoves)(long, particle< Space > &, rng *))
  Set the individual move functions to the supplied array of such functions.

- moveset< Space > & operator= (moveset< Space > &pFrom)
  Moveset assignment should allocate buffers and deep copy all members.

Private Attributes

- long number
  The number of moves which are present in the set.

- particle< Space >(* pfInitialise)(rng *)
  The function which initialises a particle.

- long(* pfMoveSelect)(long, const particle< Space > &, rng *)
  The function which selects a move for a given particle at a given time.

- void(** pfMoves)(long, particle< Space > &, rng *)
  The functions which perform actual moves.

- int(* pfMCMC)(long, particle< Space > &, rng *)
  A Markov Chain Monte Carlo move.

6.6.1 Detailed Description

template<class Space> class smc::moveset< Space >

A template class for a set of moves for use in an SMC samplers framework.

Definition at line 36 of file moveset.hh.

6.6.2 Constructor & Destructor Documentation

6.6.2.1 template<class Space> smc::moveset< Space >::moveset () [inline]

Create a completely unspecified moveset.

The argument free smc::moveset constructor simply sets the number of available moves to zero and sets all of the associated function pointers to NULL.

Definition at line 97 of file moveset.hh.

References smc::moveset< Space >::number, smc::moveset< Space >::pfInitialise, smc::moveset< Space >::pfMCMC, smc::moveset< Space >::pfMoves, and smc::moveset< Space >::pfMoveSelect.

6.6.2.2 template<class Space> smc::moveset< Space >::moveset (particle< Space >(*)(rng *) *pfInit*, void(*)(long, particle< Space > &, rng *) *pfNewMoves*, int(*)(long, particle< Space > &, rng *) *pfNewMCMC*) [inline]

Create a reduced moveset with a single move.

The three argument moveset constructor creates a new set of moves and sets all of the relevant function pointers to the supplied values. Only a single move should exist if this constructor is used.

Parameters:

pfInit The function which should be used to initialise particles when the system is initialised

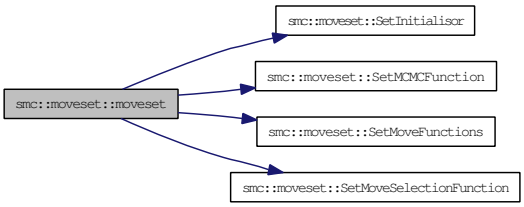
pfNewMoves An functions which moves a particle at a specified time to a new location

pfNewMCMC The function which should be called to apply an MCMC move (if any)

Definition at line 113 of file moveset.hh.

References smc::moveset< Space >::pfMoves, smc::moveset< Space >::SetInitialisor(), smc::moveset< Space >::SetMCMCFunction(), smc::moveset< Space >::SetMoveFunctions(), and smc::moveset< Space >::SetMoveSelectionFunction().

Here is the call graph for this function:



6.6.2.3 template<class Space> smc::moveset< Space >::moveset (particle< Space >(*)(rng *) *pfInit*, long(*)(long, const particle< Space > &, rng *) *pfMoveSelector*, long *nMoves*, void(**)(long, particle< Space > &, rng *) *pfNewMoves*, int(*)(long, particle< Space > &, rng *) *pfNewMCMC*) [inline]

Create a fully specified moveset.

The five argument moveset constructor creates a new set of moves and sets all of the relevant function pointers to the supplied values.

Parameters:

pfInit The function which should be used to initialise particles when the system is initialised

pfMoveSelector The function which selects a move to apply, at a specified time, to a specified particle

nMoves The number of moves which are defined in general

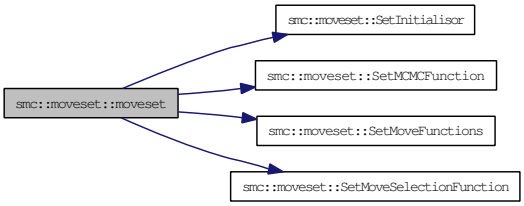
pfNewMoves An array of functions which move a particle at a specified time to a new location

pfNewMCMC The function which should be called to apply an MCMC move (if any)

Definition at line 132 of file moveset.hh.

References smc::moveset< Space >::pfMoves, smc::moveset< Space >::SetInitialisor(), smc::moveset< Space >::SetMCMCFunction(), smc::moveset< Space >::SetMoveFunctions(), and smc::moveset< Space >::SetMoveSelectionFunction().

Here is the call graph for this function:



6.6.2.4 template<class Space> smc::moveset< Space >::~moveset () [inline]

Free the memory used for the array of move pointers when deleting.

Definition at line 144 of file moveset.hh.

References smc::moveset< Space >::pfMoves.

6.6.3 Member Function Documentation

6.6.3.1 template<class Space> particle<Space> smc::moveset< Space >::DoInit (rng * *pRng*) [inline]

Initialise a particle.

Definition at line 63 of file moveset.hh.

References smc::moveset< Space >::pfInitialise.

6.6.3.2 template<class Space> int smc::moveset< Space >::DoMCMC (long *lTime*, particle< Space > & *pFrom*, rng * *pRng*) [inline]

Perform an MCMC move on a particle.

Definition at line 151 of file moveset.hh.

References smc::moveset< Space >::pfMCMC.

6.6.3.3 template<class Space> void smc::moveset< Space >::DoMove (long *lTime*, particle< Space > & *pFrom*, rng * *pRng*) [inline]

Select an appropriate move at time lTime and apply it to pFrom.

Definition at line 162 of file moveset.hh.

References smc::moveset< Space >::number, smc::moveset< Space >::pfMoves, and smc::moveset< Space >::pfMoveSelect.

6.6.3.4 template<class Space> void smc::moveset< Space >::SetInitialisor (particle< Space >(*)(rng *) *pfInit*) [inline]

Set the initialisation function.

Parameters:

pfInit is a function which returns a particle generated according to the initial distribution

Definition at line 74 of file moveset.hh.

References smc::moveset< Space >::pfInitialise.

Referenced by smc::moveset< Space >::moveset(), and smc::moveset< Space >::operator=().

6.6.3.5 template<class Space> void smc::moveset< Space >::SetMCMCFunction (int(*)(long, particle< Space > &, rng *) *pfNewMCMC*) [inline]

Set the MCMC function.

Parameters:

pfNewMCMC The function which performs an MCMC move

Definition at line 79 of file moveset.hh.

References smc::moveset< Space >::pfMCMC.

Referenced by smc::moveset< Space >::moveset(), and smc::moveset< Space >::operator=().

6.6.3.6 template<class Space> void smc::moveset< Space >::SetMoveSelectionFunction (long(*)(long, const particle< Space > &, rng *) *pfMoveSelectNew*) [inline]

Set the move selection function.

Parameters:

pfMoveSelectNew returns the index of move to perform at the specified time given a specified particle

Definition at line 83 of file moveset.hh.

References smc::moveset< Space >::pfMoveSelect.

Referenced by smc::moveset< Space >::moveset(), and smc::moveset< Space >::operator=().

6.6.3.7 template<class Space> void smc::moveset< Space >::SetMoveFunctions (long *nMoves*, void(**)(long, particle< Space > &, rng *) *pfNewMoves*) [inline]

Set the individual move functions to the supplied array of such functions.

Parameters:

nMoves The number of moves which are defined in general.

pfNewMoves An array of functions which move a particle at a specified time to a new location

The move functions accept two arguments, the first of which corresponds to the system evolution time and the second to an initial particle position and the second to a weighted starting position. It returns a new weighted position corresponding to the moved particle.

Definition at line 177 of file moveset.hh.

References smc::moveset< Space >::number, and smc::moveset< Space >::pfMoves.

Referenced by smc::moveset< Space >::moveset(), and smc::moveset< Space >::operator=().

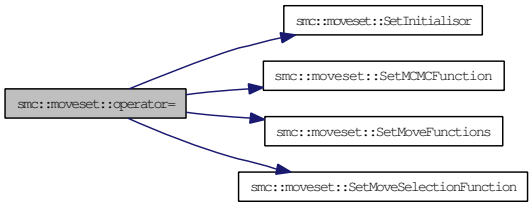
6.6.3.8 template<class Space> moveset< Space > & smc::moveset< Space >::operator= (moveset< Space > & *pFrom*) [inline]

Moveset assignment should allocate buffers and deep copy all members.

Definition at line 189 of file moveset.hh.

References smc::moveset< Space >::number, smc::moveset< Space >::pfInitialise, smc::moveset< Space >::pfMCMC, smc::moveset< Space >::pfMoves, smc::moveset< Space >::pfMoveSelect, smc::moveset< Space >::SetInitialisor(), smc::moveset< Space >::SetMCMCFunction(), smc::moveset< Space >::SetMoveFunctions(), and smc::moveset< Space >::SetMoveSelectionFunction().

Here is the call graph for this function:



6.6.4 Member Data Documentation

6.6.4.1 template<class Space> long smc::moveset< Space >::number [private]

The number of moves which are present in the set.

Definition at line 40 of file moveset.hh.

Referenced by smc::moveset< Space >::DoMove(), smc::moveset< Space >::moveset(), smc::moveset< Space >::operator=(), and smc::moveset< Space >::SetMoveFunctions().

6.6.4.2 template<class Space> particle<Space>(* smc::moveset< Space >::pfInitialise)(rng *) [private]

The function which initialises a particle.

Referenced by smc::moveset< Space >::DoInit(), smc::moveset< Space >::moveset(), smc::moveset< Space >::operator=(), and smc::moveset< Space >::SetInitialisor().

6.6.4.3 template<class Space> long(* smc::moveset< Space >::pfMoveSelect)(long, const particle< Space > &, rng *) [private]

The function which selects a move for a given particle at a given time.

Referenced by smc::moveset< Space >::DoMove(), smc::moveset< Space >::moveset(), smc::moveset< Space >::operator=(), and smc::moveset< Space >::SetMoveSelectionFunction().

6.6.4.4 template<class Space> void(** smc::moveset< Space >::pfMoves)(long, particle< Space > &, rng *) [private]

The functions which perform actual moves.

Referenced by smc::moveset< Space >::DoMove(), smc::moveset< Space >::moveset(), smc::moveset< Space >::operator=(), smc::moveset< Space >::SetMoveFunctions(), and smc::moveset< Space >::~moveset().

6.6.4.5 template<class Space> int(* smc::moveset< Space >::pfMCMC)(long, particle< Space > &, rng *) [private]

A Markov Chain Monte Carlo move.

Referenced by smc::moveset< Space >::DoMCMC(), smc::moveset< Space >::moveset(), smc::moveset< Space >::operator=(), and smc::moveset< Space >::SetMCMCFunction().

The documentation for this class was generated from the following file:

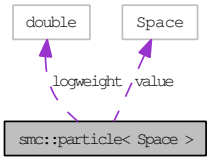
- include/moveset.hh

6.7 smc::particle< Space > Class Template Reference

A template class for the particles of an SMC algorithm.

`#include <particle.hh>`

Collaboration diagram for smc::particle< Space >:



Public Member Functions

- particle ()
  Create a particle with undefined value and weight NAN.
- particle (Space sInit, double dLogWeight)
  Constructor which initialises the particles value and weight.
- particle (const particle< Space > &pFrom)
  The copy constructor performs a shallow copy.
- particle< Space > & operator= (const particle< Space > &pFrom)
  The assignment operator performs a shallow copy.
- ~particle ()
  Dispose of a particle which is no longer required.
- Space const & GetValue (void) const
  Returns the particle's value.
- Space * GetValuePointer (void)
  Returns a pointer to the value to allow for more efficient changes.
- double GetLogWeight (void) const
  Returns the particle's log weight.
- double GetWeight (void) const
  Returns the particle's unnormalised weight.
- void Set (Space sValue, double dLogWeight)
  Sets the particle's value and weight explicitly.
- void SetValue (const Space &sValue)
  Sets the particle's value explicitly.
- void SetLogWeight (const double &dLogWeight)

Sets the particle's log weight explicitly.

- void SetWeight (const double &dWeight)
  Sets the particles weight explicitly.
- void AddToLogWeight (double dIncrement)
  Increase the log weight by a specified amount.
- void MultiplyWeightBy (double dMultiplier)
  Multiply the weight by a specified factor.

Private Attributes

- Space value
  Value of this particle.
- double logweight
  Natural logarithm of this particle's weight.

6.7.1 Detailed Description

template<class Space> class smc::particle< Space >

A template class for the particles of an SMC algorithm.

Definition at line 35 of file particle.hh.

6.7.2 Constructor & Destructor Documentation

6.7.2.1 template<class Space> smc::particle< Space >::particle () [inline]

Create a particle with undefined value and weight NAN.

Definition at line 94 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.2.2 template<class Space> smc::particle< Space >::particle (Space *sInit*, double *dLogWeight*) [inline]

Constructor which initialises the particles value and weight.

Create a particle with value sInit and log weight dLogWeight

Parameters:

sInit The initial value of the particle
dLogWeight The initial value of the natural logarithm of the particle weight

Definition at line 111 of file particle.hh.

References smc::particle< Space >::logweight, and smc::particle< Space >::value.

6.7.2.3 template<class Space> smc::particle< Space >::particle (const particle< Space > & *pFrom*) [inline]

The copy constructor performs a shallow copy.

Copy constructor.

Definition at line 101 of file particle.hh.

References smc::particle< Space >::logweight, and smc::particle< Space >::value.

6.7.2.4 template<class Space> smc::particle< Space >::~particle () [inline]

Dispose of a particle which is no longer required.

Definition at line 119 of file particle.hh.

6.7.3 Member Function Documentation

6.7.3.1 template<class Space> particle< Space > & smc::particle< Space >::operator= (const particle< Space > & *pFrom*) [inline]

The assignment operator performs a shallow copy.

Copy the values of pFrom to the values of this to set this particle identical to pFrom in a deep copy sense.

Definition at line 126 of file particle.hh.

References smc::particle< Space >::logweight, and smc::particle< Space >::value.

6.7.3.2 template<class Space> Space const& smc::particle< Space >::GetValue (void) const [inline]

Returns the particle's value.

Definition at line 55 of file particle.hh.

References smc::particle< Space >::value.

6.7.3.3 template<class Space> Space* smc::particle< Space >::GetValuePointer (void) [inline]

Returns a pointer to the value to allow for more efficient changes.

Definition at line 57 of file particle.hh.

References smc::particle< Space >::value.

6.7.3.4 template<class Space> double smc::particle< Space >::GetLogWeight (void) const [inline]

Returns the particle's log weight.

Definition at line 59 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.3.5 template<class Space> double smc::particle< Space >::GetWeight (void) const [inline]

Returns the particle's unnormalised weight.

Definition at line 61 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.3.6 template<class Space> void smc::particle< Space >::Set (Space *sValue*, double *dLogWeight*) [inline]

Sets the particle's value and weight explicitly.

Parameters:

sValue The particle value to use

dLogWeight The natural logarithm of the new particle weight

Definition at line 67 of file particle.hh.

References smc::particle< Space >::logweight, and smc::particle< Space >::value.

6.7.3.7 template<class Space> void smc::particle< Space >::SetValue (const Space & *sValue*) [inline]

Sets the particle's value explicitly.

Parameters:

sValue The particle value to use

Definition at line 71 of file particle.hh.

References smc::particle< Space >::value.

6.7.3.8 template<class Space> void smc::particle< Space >::SetLogWeight (const double & *dLogWeight*) [inline]

Sets the particle's log weight explicitly.

Parameters:

dLogWeight The natural logarithm of the new particle weight

Definition at line 75 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.3.9 template<class Space> void smc::particle< Space >::SetWeight (const double & *dWeight*) [inline]

Sets the particles weight explicitly.

Parameters:

dWeight The new particle weight

Definition at line 79 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.3.10 template<class Space> void smc::particle< Space >::AddToLogWeight (double *dIncrement*) [inline]

Increase the log weight by a specified amount.

Parameters:

dIncrement The amount to add to the log weight.

Definition at line 84 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.3.11 template<class Space> void smc::particle< Space >::MultiplyWeightBy (double *dMultiplier*) [inline]

Multiply the weight by a specified factor.

Parameters:

dMultiplier The factor to multiply the weight by.

Definition at line 88 of file particle.hh.

References smc::particle< Space >::logweight.

6.7.4 Member Data Documentation

6.7.4.1 template<class Space> Space smc::particle< Space >::value [private]

Value of this particle.

Definition at line 39 of file particle.hh.

Referenced by smc::particle< Space >::GetValue(), smc::particle< Space >::GetValuePointer(), smc::particle< Space >::operator=(), smc::particle< Space >::particle(), smc::particle< Space >::Set(), and smc::particle< Space >::SetValue().

6.7.4.2 template<class Space> double smc::particle< Space >::logweight [private]

Natural logarithm of this particle's weight.

Definition at line 41 of file particle.hh.

Referenced by smc::particle< Space >::AddToLogWeight(), smc::particle< Space >::GetLogWeight(), smc::particle< Space >::GetWeight(), smc::particle< Space >::MultiplyWeightBy(), smc::particle<

Space >::operator=(), smc::particle< Space >::particle(), smc::particle< Space >::Set(), smc::particle< Space >::SetLogWeight(), and smc::particle< Space >::SetWeight().

The documentation for this class was generated from the following file:

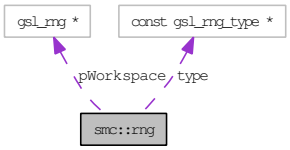
- include/particle.hh

6.8 smc::rng Class Reference

A random number generator class.

`#include <rng.hh>`

Collaboration diagram for smc::rng:



Public Member Functions

- rng ()

  Initialise the random number generator using default settings.

- rng (const gsl_rng_type ∗Type)

  Initialise the random number generator using the default seed for the type.

- rng (const gsl_rng_type ∗Type, unsigned long int lSeed)

  Initialise the random number generator using specified type and seed.

- ∼rng ()

  Free the workspace allocated for random number generation.

- gsl_rng ∗ GetRaw (void)

  Provide access to the raw random number generator.

- void Multinomial (unsigned n, unsigned k, const double ∗w, unsigned ∗X)

  Generate a multinomial random vector with parameters (n,w[1:k]) and store it in X.

- long UniformDiscrete (long lMin, long lMax)

  Returns a random integer generated uniformly between the minimum and maximum values specified.

- double Beta (double da, double db)

  Returns a random number generated from a Beta distribution with the specified parameters.

- double Cauchy (double dScale)

  Returns a random number generated from a Cauchy distribution with the specified scale parameter.

- double Exponential (double dMean)

  Returns a random number generated from an exponential distribution with the specified mean.

- double Gamma (double dAlpha, double dBeta)

  Return a random number generated from a gamma distribution with shape alpha and scale beta.

- double Laplacian (double dScale)

Returns a random number generated from a Laplacian distribution with the specified scale.

- double Lognormal (double dMu, double dSigma)

  Returns a random number generated from a Lognormal distribution of location mu and scale sigma.

- double Normal (double dMean, double dStd)

  Return a random number generated from a normal distribution with a specified mean and standard deviation.

- double NormalS (void)

  Return a random number generated from a standard normal distribution.

- double NormalTruncated (double dMean, double dStd, double dThreshold)

  Returns a random number from a normal distribution, conditional upon it exceeding the specified threshold.

- double StudentT (double dDF)

  Return a student-t random number generated with a specified number of degrees of freedom.

- double Uniform (double dMin, double dMax)

  Return a random number generated uniformly between dMin and dMax.

- double UniformS (void)

  Returns a random number generated from the standard uniform[0,1) distribution.

Private Attributes

- const gsl_rng_type * type

  This is the type of random number generator underlying the class.

- gsl_rng * pWorkspace

  This is a pointer to the internal workspace of the rng including its current state.

6.8.1 Detailed Description

A random number generator class.

At present this serves as a wrapper for the gsl random number generation code.

Definition at line 67 of file rng.hh.

6.8.2 Constructor & Destructor Documentation

6.8.2.1 smc::rng::rng (void)

Initialise the random number generator using default settings.

When called without any arguments, the constructor for the smc::rng class simply allocates a buffer for a random number generator of type gsl_rng_default (something which can be set at run-time via an environment variable) using its default seed (which again can be over-ridden using an environment variable).

Definition at line 83 of file rng.cc.

References pWorkspace, and type.

6.8.2.2 smc::rng::rng (const gsl_rng_type * *Type*)

Initialise the random number generator using the default seed for the type.

When called with a single argument, the constructor for the smc::rng class allocates a buffer for a random number generator of the specified type and initialises it with the default seed (which can be set using and environment variable if one wishes to vary it at run-time).

Parameters:

Type The type of a GSL random number generator

Definition at line 95 of file rng.cc.

References pWorkspace, and type.

6.8.2.3 smc::rng::rng (const gsl_rng_type * *Type*, unsigned long int *lSeed*)

Initialise the random number generator using specified type and seed.

When called with a pair of arguments, the constructor for the smc::rng class allocates a buffer for the specified random number generator type and initialises it with the specified seed (note that zero has special significance and is used to specify the seed with which the generator was originally used).

Parameters:

Type The type of a GSL random number generator

lSeed The value with which the generator is to be seeded

Definition at line 108 of file rng.cc.

References pWorkspace, and type.

6.8.2.4 smc::rng::~rng ()

Free the workspace allocated for random number generation.

The destructor presently does no more than call the gsl_rng_free function to deallocate the memory which was previously allocate to the random number generator.

Definition at line 118 of file rng.cc.

References pWorkspace.

6.8.3 Member Function Documentation

6.8.3.1 gsl_rng * smc::rng::GetRaw (void)

Provide access to the raw random number generator.

This function returns a pointer to the underlying GSL random number generator which may be used to provide random number facilities which are not explicitly provided by the intermediate layer of smc::rng.

Definition at line 125 of file rng.cc.

References pWorkspace.

6.8.3.2 void smc::rng::Multinomial (unsigned *n*, unsigned *k*, const double * *w*, unsigned * *X*)

Generate a multinomial random vector with parameters (n,w[1:k]) and store it in X.

This function simply passes the relevant arguments on to gsl_ran_multinomial.

Parameters:

n Number of entities to assign.

k Number of categories.

w Weights of category elements

X Array in which to return the sample values.

Definition at line 135 of file rng.cc.

References pWorkspace.

Referenced by smc::sampler< Space >::Resample().

6.8.3.3 long smc::rng::UniformDiscrete (long *lMin*, long *lMax*)

Returns a random integer generated uniformly between the minimum and maximum values specified.

This function simply calls gsl_rng_uniform_int and shifts the result as appropriate such that the result is an integer generated uniformly from those between the two arguments (inclusive of those points).

Parameters:

lMin The smallest value which can be returned

lMax the largest value which can be returned

Definition at line 147 of file rng.cc.

References pWorkspace.

6.8.3.4 double smc::rng::Beta (double *da*, double *db*)

Returns a random number generated from a Beta distribution with the specified parameters.

This function simply calls gsl_ran_beta with the specified parameters.

Parameters:

da The parameter associated with "x". db The parameter associated with "1-x".

Definition at line 155 of file rng.cc.

References pWorkspace.

6.8.3.5 double smc::rng::Cauchy (double *dScale*)

Returns a random number generated from a Cauchy distribution with the specified scale parameter.
This function simply calls gsl_ran_cauchy with the specified parameter.

Parameters:

dScale The scale parameter of the distribution.

Definition at line 162 of file rng.cc.
References pWorkspace.

6.8.3.6 double smc::rng::Exponential (double *dMean*)

Returns a random number generated from an exponential distribution with the specified mean.
This function simply calls gsl_ran_exponential with the specified parameters.

Parameters:

dMean The scale (not rate) (and mean) of the distribution.

Definition at line 169 of file rng.cc.
References pWorkspace.

6.8.3.7 double smc::rng::Gamma (double *dAlpha*, double *dBeta*)

Return a random number generated from a gamma distribution with shape alpha and scale beta.
This function simply calls gsl_ran_gamma with the specified parameters.

Parameters:

dAlpha The shape of the distribution (integers lead to Erlang distributions)

dBeta The scale (not rate) of the distribution.

Definition at line 177 of file rng.cc.
References pWorkspace.

6.8.3.8 double smc::rng::Laplacian (double *dScale*)

Returns a random number generated from a Laplacian distribution with the specified scale.
This function simply calls gsl_ran_laplace with the specified parameters.

Parameters:

dScale The scale (not rate) of the distribution.

Definition at line 185 of file rng.cc.
References pWorkspace.

6.8.3.9 double smc::rng::Lognormal (double *dMu*, double *dSigma*)

Returns a random number generated from a Lognormal distribution of location mu and scale sigma.

This function simply calls gsl_ran_lognormal with the specified parameters.

Parameters:

dMu The location parameter of the distribution.

dSigma The scale parameter of the distribution.

Definition at line 193 of file rng.cc.

References pWorkspace.

6.8.3.10 double smc::rng::Normal (double *dMean*, double *dStd*)

Return a random number generated from a normal distribution with a specified mean and standard deviation.

This function simply calls gsl_ran_gaussian with the specified standard deviation and shifts the result.

Parameters:

dMean The mean of the distribution.

dStd The standard deviation of the distribution

Definition at line 201 of file rng.cc.

References pWorkspace.

6.8.3.11 double smc::rng::NormalS (void)

Return a random number generated from a standard normal distribution.

This function simply calls gsl_ran_ugaussian returns the result.

Definition at line 207 of file rng.cc.

References pWorkspace.

6.8.3.12 double smc::rng::NormalTruncated (double *dMean*, double *dStd*, double *dThreshold*)

Returns a random number from a normal distribution, conditional upon it exceeding the specified threshold.

This function simply calls gsl_ran_gaussian_tail with the specified parameters and performs appropriate shifting.

Parameters:

dMean The mean of the distribution.

dStd The standard deviation of the distribution

dThreshold The lower truncation threshold.

Definition at line 216 of file rng.cc.

References pWorkspace.

6.8.3.13 double smc::rng::StudentT (double *dDF*)

Return a student-t random number generated with a specified number of degrees of freedom.

This function simply calls gsl_ran_tdist with the specified number of degrees of freedom.

Parameters:

dDF The number of degrees of freedom.

Definition at line 223 of file rng.cc.

References pWorkspace.

6.8.3.14 double smc::rng::Uniform (double *dMin*, double *dMax*)

Return a random number generated uniformly between dMin and dMax.

This function simply calls gsl_rng_uniform and scales and shifts appropriately.

Parameters:

dMin The lowest value with positive density.

dMax The largest value with positive density.

Definition at line 231 of file rng.cc.

References pWorkspace.

Referenced by smc::sampler< Space >::Resample().

6.8.3.15 double smc::rng::UniformS (void)

Returns a random number generated from the standard uniform[0,1) distribution.

This function simply calls gsl_rng_uniform.

Definition at line 243 of file rng.cc.

References pWorkspace.

6.8.4 Member Data Documentation

6.8.4.1 const gsl_rng_type* smc::rng::type [private]

This is the type of random number generator underlying the class.

Definition at line 70 of file rng.hh.

Referenced by rng().

6.8.4.2 gsl_rng* smc::rng::pWorkspace [private]

This is a pointer to the internal workspace of the rng including its current state.

Definition at line 72 of file rng.hh.

Referenced by Beta(), Cauchy(), Exponential(), Gamma(), GetRaw(), Laplacian(), Lognormal(), Multinomial(), Normal(), NormalS(), NormalTruncated(), rng(), StudentT(), Uniform(), UniformDiscrete(), UniformS(), and ∼rng().

The documentation for this class was generated from the following files:

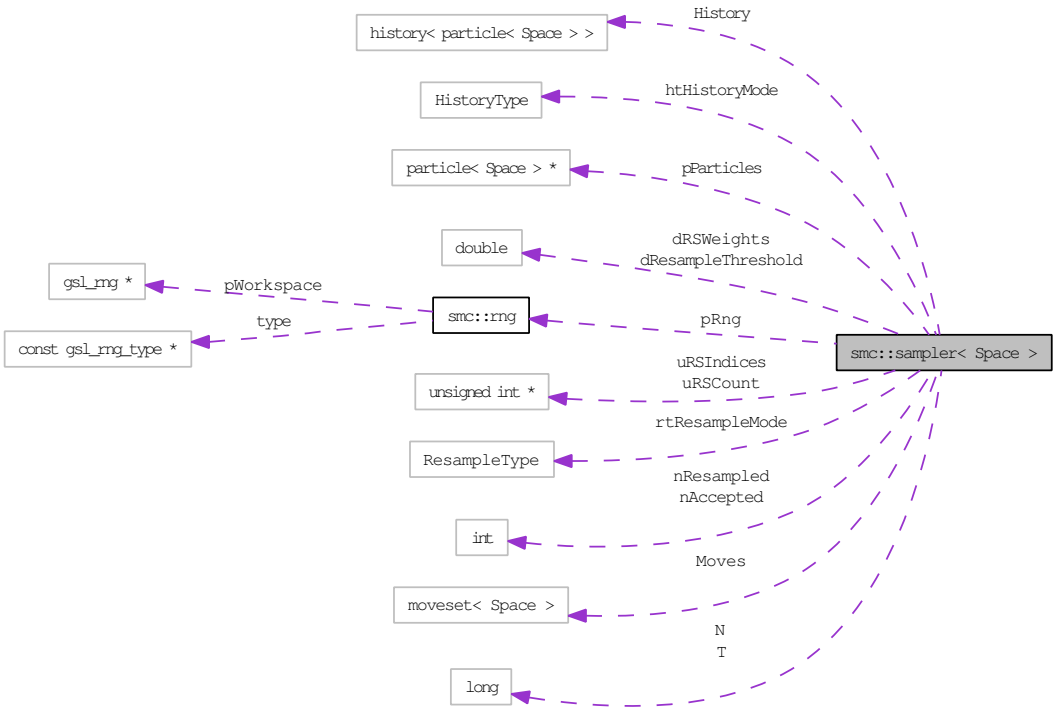
- include/rng.hh
- src/rng.cc

6.9 smc::sampler< Space > Class Template Reference

A template class for an interacting particle system suitable for SMC sampling.

`#include <sampler.hh>`

Collaboration diagram for smc::sampler< Space >:



Public Member Functions

- sampler (long lSize, HistoryType htHistoryMode)

  Create an particle system containing lSize uninitialised particles with the specified mode.

- sampler (long lSize, HistoryType htHistoryMode, const gsl_rng_type *rngType, unsigned long nSeed)

  Create an particle system containing lSize uninitialised particles with the specified mode and random number generator.

- ~sampler ()

  Dispose of a sampler.

- double GetESS (void) const

  Calculates and Returns the Effective Sample Size.

- const history< particle< Space > > * GetHistory (void) const

  Returns a pointer to the History of the particle system.

- long GetNumber (void) const

Returns the number of particles within the system.

- const Space & GetParticleValue (int n)

  Return the value of particle n.

- double GetParticleLogWeight (int n)

  Return the logarithmic unnormalized weight of particle n.

- double GetParticleWeight (int n)

  Return the unnormalized weight of particle n.

- long GetTime (void) const

  Returns the current evolution time of the system.

- void Initialise (void)

  Initialise the sampler and its constituent particles.

- double Integrate (double(*pIntegrand)(const Space &, void *), void *pAuxiliary)

  Integrate the supplied function with respect to the current particle set.

- double IntegratePathSampling (double(*pIntegrand)(long, const particle< Space > &, void *), double(*pWidth)(long, void *), void *pAuxiliary)

  Integrate the supplied function over the path path using the supplied width function.

- void Iterate (void)

  Perform one iteration of the simulation algorithm.

- void IterateBack (void)

  Cancel one iteration of the simulation algorithm.

- double IterateEss (void)

  Perform one iteration of the simulation algorithm and return the resulting ess.

- void IterateUntil (long lTerminate)

  Perform iterations until the specified evolution time is reached.

- void MoveParticles (void)

  Move the particle set by proposing an applying an appropriate move to each particle.

- void Resample (ResampleType lMode)

  Resample the particle set using the specified resmpling scheme.

- void SetMoveSet (moveset< Space > &pNewMoveset)

  Sets the entire moveset to the one which is supplied.

- void SetResampleParams (ResampleType rtMode, double dThreshold)

  Set Resampling Parameters.

- std::ostream & StreamParticle (std::ostream &os, long n)

  Dump a specified particle to the specified output stream in a human readable form.

- std::ostream & StreamParticles (std::ostream &os)

  Dump the entire particle set to the specified output stream in a human readable form.

Private Member Functions

- sampler (const sampler< Space > &sFrom)

  Duplication of smc::sampler is not currently permitted.

- sampler< Space > & operator= (const sampler< Space > &sFrom)

  Duplication of smc::sampler is not currently permitted.

Private Attributes

- rng * pRng

  A random number generator.

- long N

  Number of particles in the system.

- long T

  The current evolution time of the system.

- ResampleType rtResampleMode

  The resampling mode which is to be employed.

- double dResampleThreshold

  The effective sample size at which resampling should be used.

- double * dRSWeights

  Structure used internally for resampling.

- unsigned int * uRSCount

  Structure used internally for resampling.

- unsigned int * uRSIndices

  Structure used internally for resampling.

- particle< Space > * pParticles

  The particles within the system.

- moveset< Space > Moves

  The set of moves available.

- int nAccepted

  The number of MCMC moves which have been accepted during this iteration.

- int nResampled

  A flag which tracks whether the ensemble was resampled during this iteration.

- HistoryType htHistoryMode

  A mode flag which indicates whether historical information is stored.

- history< particle< Space > > History

  The historical process associated with the particle system.

6.9.1 Detailed Description

template<class Space> class smc::sampler< Space >

A template class for an interacting particle system suitable for SMC sampling.

Definition at line 53 of file sampler.hh.

6.9.2 Constructor & Destructor Documentation

6.9.2.1 template<class Space> smc::sampler< Space >::sampler (long *lSize*, HistoryType *htHM*) [inline]

Create an particle system containing lSize uninitialised particles with the specified mode.

The constructor prepares a sampler for use but does not assign any moves to the moveset, initialise the particles or otherwise perform any sampling related tasks. Its main function is to allocate a region of memory in which to store the particle set and to initialise a random number generator.

Parameters:

lSize The number of particles present in the ensemble (at time 0 if this is a variable quantity)

htHM The history mode to use: set this to SMC_HISTORY_RAM to store the whole history of the system and SMC_HISTORY_NONE to avoid doing so.

Template Parameters:

Space The class used to represent a point in the sample space.

Structure used internally for resampling.

Structure used internally for resampling.

Definition at line 156 of file sampler.hh.

References smc::sampler< Space >::dResampleThreshold, smc::sampler< Space >::dRSWeights, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::N, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, smc::sampler< Space >::rtResampleMode, SMC_RESAMPLE_STRATIFIED, smc::sampler< Space >::uRSCount, and smc::sampler< Space >::uRSIndices.

6.9.2.2 template<class Space> smc::sampler< Space >::sampler (long *lSize*, HistoryType *htHM*, const gsl_rng_type * *rngType*, unsigned long *rngSeed*) [inline]

Create an particle system constaining lSize uninitialised particles with the specified mode and random number generator.

The constructor prepares a sampler for use but does not assign any moves to the moveset, initialise the particles or otherwise perform any sampling related tasks. Its main function is to allocate a region of memory in which to store the particle set and to initialise a random number generator.

Parameters:

lSize The number of particles present in the ensemble (at time 0 if this is a variable quantity)

htHM The history mode to use: set this to SMC_HISTORY_RAM to store the whole history of the system and SMC_HISTORY_NONE to avoid doing so.

rngType The type of random number generator to use

rngSeed The seed to use for the random number generator

Template Parameters:

Space The class used to represent a point in the sample space.

Structure used internally for resampling.

Structure used internally for resampling.

Definition at line 185 of file sampler.hh.

References smc::sampler< Space >::dResampleThreshold, smc::sampler< Space >::dRSWeights, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::N, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, smc::sampler< Space >::rtResampleMode, SMC_HISTORY_RAM, SMC_RESAMPLE_STRATIFIED, smc::sampler< Space >::uRSCount, and smc::sampler< Space >::uRSIndices.

6.9.2.3 template<class Space> smc::sampler< Space >::~sampler () [inline]

Dispose of a sampler.

Definition at line 206 of file sampler.hh.

References smc::sampler< Space >::dRSWeights, smc::sampler< Space >::pRng, smc::sampler< Space >::uRSCount, and smc::sampler< Space >::uRSIndices.

6.9.2.4 template<class Space> smc::sampler< Space >::sampler (const sampler< Space > & *sFrom*) [private]

Duplication of smc::sampler is not currently permitted.

Allow a human readable version of the sampler configuration to be produced using the stream operator. std::ostream & operator<< (std::ostream& os, sampler<Space> & s);

6.9.3 Member Function Documentation

6.9.3.1 template<class Space> double smc::sampler< Space >::GetESS (void) const [inline]

Calculates and Returns the Effective Sample Size.

Definition at line 219 of file sampler.hh.

References smc::sampler< Space >::N, and smc::sampler< Space >::pParticles.

Referenced by smc::sampler< Space >::IterateEss().

6.9.3.2 template<class Space> const history<particle<Space> >* smc::sampler< Space >::GetHistory (void) const [inline]

Returns a pointer to the History of the particle system.

Definition at line 100 of file sampler.hh.

References smc::sampler< Space >::History.

6.9.3.3 template<class Space> long smc::sampler< Space >::GetNumber (void) const [inline]

Returns the number of particles within the system.

Definition at line 102 of file sampler.hh.

References smc::sampler< Space >::N.

6.9.3.4 template<class Space> const Space& smc::sampler< Space >::GetParticleValue (int *n*) [inline]

Return the value of particle n.

Definition at line 104 of file sampler.hh.

References smc::sampler< Space >::pParticles.

6.9.3.5 template<class Space> double smc::sampler< Space >::GetParticleLogWeight (int *n*) [inline]

Return the logarithmic unnormalized weight of particle n.

Definition at line 106 of file sampler.hh.

References smc::sampler< Space >::pParticles.

6.9.3.6 template<class Space> double smc::sampler< Space >::GetParticleWeight (int *n*) [inline]

Return the unnormalized weight of particle n.

Definition at line 108 of file sampler.hh.

References smc::sampler< Space >::pParticles.

6.9.3.7 template<class Space> long smc::sampler< Space >::GetTime (void) const [inline]

Returns the current evolution time of the system.

Definition at line 110 of file sampler.hh.

References smc::sampler< Space >::T.

6.9.3.8 template<class Space> void smc::sampler< Space >::Initialise (void) [inline]

Initialise the sampler and its constituent particles.

At present this function resets the system evolution time to 0 and calls the moveset initialisor to assign each particle in the ensemble.

Note that the initialisation function must be specified before calling this function.

Definition at line 238 of file sampler.hh.

References smc::sampler< Space >::History, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::Moves, smc::sampler< Space >::N, smc::sampler< Space >::nResampled, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, SMC_HISTORY_NONE, and smc::sampler< Space >::T.

6.9.3.9 template<class Space> double smc::sampler< Space >::Integrate (double(*)(const Space &, void *) *pIntegrand*, void * *pAuxiliary*) [inline]

Integrate the supplied function with respect to the current particle set.

This function returns the result of integrating the supplied function under the empirical measure associated with the particle set at the present time. The final argument of the integrand function is a pointer which will be supplied with pAuxiliary to allow for arbitrary additional information to be passed to the function being integrated.

Parameters:

pIntegrand The function to integrate with respect to the particle set

pAuxiliary A pointer to any auxiliary data which should be passed to the function

Definition at line 262 of file sampler.hh.

References smc::sampler< Space >::N, and smc::sampler< Space >::pParticles.

6.9.3.10 template<class Space> double smc::sampler< Space >::IntegratePathSampling (double(*)(long, const particle< Space > &, void *) *pIntegrand*, double(*)(long, void *) *pWidth*, void * *pAuxiliary*) [inline]

Integrate the supplied function over the path path using the supplied width function.

This function is intended to be used to estimate integrals of the sort which must be evaluated to determine the normalising constant of a distribution obtain using a sequence of potential functions proportional to densities with respect to the initial distribution to define a sequence of distributions leading up to the terminal, interesting distribution.

In this context, the particle set at each time is used to make an estimate of the path sampling integrand, and a trapezoidal integration is then performed to obtain an estimate of the path sampling integral which is the natural logarithm of the ratio of normalising densities.

Parameters:

pIntegrand The quantity which we wish to integrate at each time

pWidth A pointer to a function which specifies the width of each

Definition at line 288 of file sampler.hh.

References smc::sampler< Space >::History, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::N, smc::sampler< Space >::nAccepted, smc::sampler< Space >::nResampled, smc::sampler< Space >::pParticles, SMC_EXCEPTION, SMC_HISTORY_NONE, and SMCX_MISSING_HISTORY.

6.9.3.11 template<class Space> void smc::sampler< Space >::Iterate (void) [inline]

Perform one iteration of the simulation algorithm.

The iterate function:

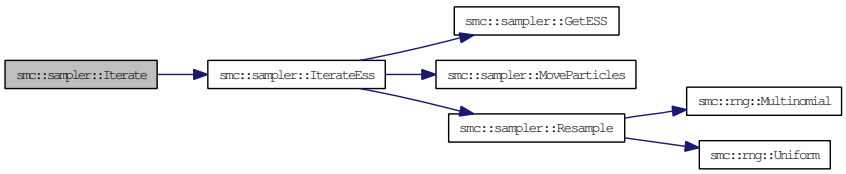
1. appends the current particle set to the history if desired
   (a) moves the current particle set
2. checks the effective sample size and resamples if necessary
3. performs a mcmc step if required
4. increments the current evolution time

Definition at line 306 of file sampler.hh.

References smc::sampler< Space >::IterateEss().

Referenced by smc::sampler< Space >::IterateUntil().

Here is the call graph for this function:



6.9.3.12 template<class Space> void smc::sampler< Space >::IterateBack (void) [inline]

Cancel one iteration of the simulation algorithm.

Definition at line 313 of file sampler.hh.

References smc::sampler< Space >::History, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::N, smc::sampler< Space >::nAccepted, smc::sampler< Space >::pParticles, SMC_EXCEPTION, SMC_HISTORY_NONE, SMCX_MISSING_HISTORY, and smc::sampler< Space >::T.

6.9.3.13 template<class Space> double smc::sampler< Space >::IterateEss (void) [inline]

Perform one iteration of the simulation algorithm and return the resulting ess.

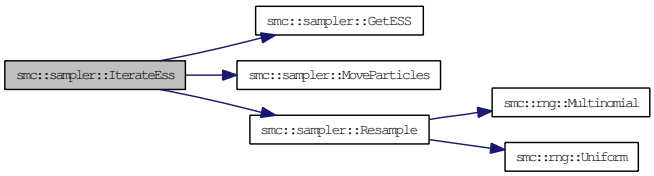
Definition at line 324 of file sampler.hh.

References smc::sampler< Space >::dResampleThreshold, smc::sampler< Space >::GetESS(), smc::sampler< Space >::History, smc::sampler< Space >::htHistoryMode, smc::sampler< Space >::MoveParticles(), smc::sampler< Space >::Moves, smc::sampler< Space >::N, smc::sampler< Space

>::nAccepted, smc::sampler< Space >::nResampled, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, smc::sampler< Space >::Resample(), smc::sampler< Space >::rtResampleMode, SMC_-HISTORY_NONE, and smc::sampler< Space >::T.

Referenced by smc::sampler< Space >::Iterate().

Here is the call graph for this function:



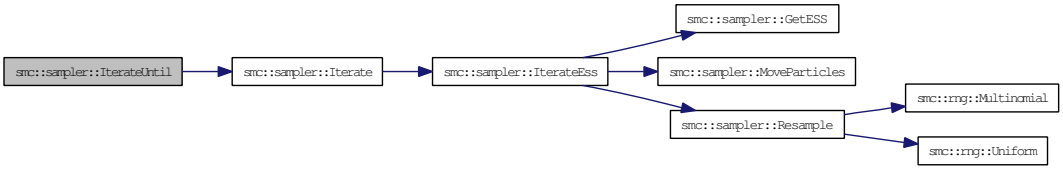
6.9.3.14 template<class Space> void smc::sampler< Space >::IterateUntil (long *lTerminate*) [inline]

Perform iterations until the specified evolution time is reached.

Definition at line 364 of file sampler.hh.

References smc::sampler< Space >::Iterate(), and smc::sampler< Space >::T.

Here is the call graph for this function:



6.9.3.15 template<class Space> void smc::sampler< Space >::MoveParticles (void) [inline]

Move the particle set by proposing an applying an appropriate move to each particle.

Definition at line 371 of file sampler.hh.

References smc::sampler< Space >::Moves, smc::sampler< Space >::N, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, and smc::sampler< Space >::T.

Referenced by smc::sampler< Space >::IterateEss().

6.9.3.16 template<class Space> void smc::sampler< Space >::Resample (ResampleType *lMode*) [inline]

Resample the particle set using the specified resmpling scheme.

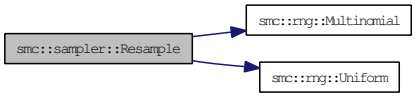
Definition at line 380 of file sampler.hh.

References smc::sampler< Space >::dRSWeights, smc::rng::Multinomial(), smc::sampler< Space >::N, smc::sampler< Space >::pParticles, smc::sampler< Space >::pRng, SMC_RESAMPLE_-MULTINOMIAL, SMC_RESAMPLE_RESIDUAL, SMC_RESAMPLE_STRATIFIED, SMC_-

RESAMPLE_SYSTEMATIC, smc::rng::Uniform(), smc::sampler< Space >::uRSCount, and smc::sampler< Space >::uRSIndices.

Referenced by smc::sampler< Space >::IterateEss().

Here is the call graph for this function:



6.9.3.17 template<class Space> void smc::sampler< Space >::SetMoveSet (moveset< Space > & *pNewMoveset*) [inline]

Sets the entire moveset to the one which is supplied.

Definition at line 130 of file sampler.hh.

References smc::sampler< Space >::Moves.

6.9.3.18 template<class Space> void smc::sampler< Space >::SetResampleParams (ResampleType *rtMode*, double *dThreshold*) [inline]

Set Resampling Parameters.

This function configures the resampling parameters, allowing the specification of both the resampling mode and the threshold at which resampling is used.

Parameters:

rtMode The resampling mode to be used.

dThreshold The threshold at which resampling is deemed necesary.

The rtMode parameter should be set to one of the following:

1. SMC_RESAMPLE_MULTINOMIAL to use multinomial resampling
2. SMC_RESAMPLE_RESIDUAL to use residual resampling
3. SMC_RESAMPLE_STRATIFIED to use stratified resampling
4. SMC_RESAMPLE_SYSTEMATIC to use systematic resampling

The dThreshold parameter can be set to a value in the range [0,1) corresponding to a fraction of the size of the particle set or it may be set to an integer corresponding to an actual effective sample size.

Definition at line 512 of file sampler.hh.

References smc::sampler< Space >::dResampleThreshold, smc::sampler< Space >::N, and smc::sampler< Space >::rtResampleMode.

6.9.3.19 template<class Space> std::ostream & smc::sampler< Space >::StreamParticle (std::ostream & *os*, long *n*) [inline]

Dump a specified particle to the specified output stream in a human readable form.

Definition at line 522 of file sampler.hh.

References smc::sampler< Space >::pParticles.

6.9.3.20 template<class Space> std::ostream & smc::sampler< Space >::StreamParticles (std::ostream & *os*) [inline]

Dump the entire particle set to the specified output stream in a human readable form.

Definition at line 529 of file sampler.hh.

References smc::sampler< Space >::N, and smc::sampler< Space >::pParticles.

6.9.3.21 template<class Space> sampler<Space>& smc::sampler< Space >::operator= (const sampler< Space > & *sFrom*) [private]

Duplication of smc::sampler is not currently permitted.

6.9.4 Member Data Documentation

6.9.4.1 template<class Space> rng* smc::sampler< Space >::pRng [private]

A random number generator.

Definition at line 57 of file sampler.hh.

Referenced by smc::sampler< Space >::Initialise(), smc::sampler< Space >::IterateEss(), smc::sampler< Space >::MoveParticles(), smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::~sampler().

6.9.4.2 template<class Space> long smc::sampler< Space >::N [private]

Number of particles in the system.

Definition at line 60 of file sampler.hh.

Referenced by smc::sampler< Space >::GetESS(), smc::sampler< Space >::GetNumber(), smc::sampler< Space >::Initialise(), smc::sampler< Space >::Integrate(), smc::sampler< Space >::IntegratePathSampling(), smc::sampler< Space >::IterateBack(), smc::sampler< Space >::IterateEss(), smc::sampler< Space >::MoveParticles(), smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), smc::sampler< Space >::SetResampleParams(), and smc::sampler< Space >::StreamParticles().

6.9.4.3 template<class Space> long smc::sampler< Space >::T [private]

The current evolution time of the system.

Definition at line 62 of file sampler.hh.

Referenced by smc::sampler< Space >::GetTime(), smc::sampler< Space >::Initialise(), smc::sampler< Space >::IterateBack(), smc::sampler< Space >::IterateEss(), smc::sampler< Space >::IterateUntil(), and smc::sampler< Space >::MoveParticles().

6.9.4.4 template<class Space> ResampleType smc::sampler< Space >::rtResampleMode [private]

The resampling mode which is to be employed.

Definition at line 65 of file sampler.hh.

Referenced by smc::sampler< Space >::IterateEss(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::SetResampleParams().

6.9.4.5 template<class Space> double smc::sampler< Space >::dResampleThreshold [private]

The effective sample size at which resampling should be used.

Definition at line 67 of file sampler.hh.

Referenced by smc::sampler< Space >::IterateEss(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::SetResampleParams().

6.9.4.6 template<class Space> double* smc::sampler< Space >::dRSWeights [private]

Structure used internally for resampling.

Definition at line 69 of file sampler.hh.

Referenced by smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::~sampler().

6.9.4.7 template<class Space> unsigned int* smc::sampler< Space >::uRSCount [private]

Structure used internally for resampling.

Definition at line 71 of file sampler.hh.

Referenced by smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::~sampler().

6.9.4.8 template<class Space> unsigned int* smc::sampler< Space >::uRSIndices [private]

Structure used internally for resampling.

Definition at line 73 of file sampler.hh.

Referenced by smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), and smc::sampler< Space >::~sampler().

6.9.4.9 template<class Space> particle<Space>* smc::sampler< Space >::pParticles [private]

The particles within the system.

Definition at line 76 of file sampler.hh.

Referenced by smc::sampler< Space >::GetESS(), smc::sampler< Space >::GetParticleLogWeight(), smc::sampler< Space >::GetParticleValue(), smc::sampler< Space >::GetParticleWeight(), smc::sampler< Space >::Initialise(), smc::sampler< Space >::Integrate(), smc::sampler< Space >::IntegratePathSampling(), smc::sampler< Space >::IterateBack(), smc::sampler< Space >::IterateEss(), smc::sampler< Space >::MoveParticles(), smc::sampler< Space >::Resample(), smc::sampler< Space >::sampler(), smc::sampler< Space >::StreamParticle(), and smc::sampler< Space >::StreamParticles().

6.9.4.10 template<class Space> moveset<Space> smc::sampler< Space >::Moves [private]

The set of moves available.

Definition at line 78 of file sampler.hh.

Referenced by smc::sampler< Space >::Initialise(), smc::sampler< Space >::IterateEss(), smc::sampler< Space >::MoveParticles(), and smc::sampler< Space >::SetMoveSet().

6.9.4.11 template<class Space> int smc::sampler< Space >::nAccepted [private]

The number of MCMC moves which have been accepted during this iteration.

Definition at line 81 of file sampler.hh.

Referenced by smc::sampler< Space >::IntegratePathSampling(), smc::sampler< Space >::IterateBack(), and smc::sampler< Space >::IterateEss().

6.9.4.12 template<class Space> int smc::sampler< Space >::nResampled [private]

A flag which tracks whether the ensemble was resampled during this iteration.

Definition at line 83 of file sampler.hh.

Referenced by smc::sampler< Space >::Initialise(), smc::sampler< Space >::IntegratePathSampling(), and smc::sampler< Space >::IterateEss().

6.9.4.13 template<class Space> HistoryType smc::sampler< Space >::htHistoryMode [private]

A mode flag which indicates whether historical information is stored.

Definition at line 86 of file sampler.hh.

Referenced by smc::sampler< Space >::Initialise(), smc::sampler< Space >::IntegratePathSampling(), smc::sampler< Space >::IterateBack(), smc::sampler< Space >::IterateEss(), and smc::sampler< Space >::sampler().

6.9.4.14 template<class Space> history<particle<Space> > smc::sampler< Space >::History [private]

The historical process associated with the particle system.

Definition at line 88 of file sampler.hh.

Referenced by smc::sampler< Space >::GetHistory(), smc::sampler< Space >::Initialise(), smc::sampler< Space >::IntegratePathSampling(), smc::sampler< Space >::IterateBack(), and smc::sampler< Space >::IterateEss().

The documentation for this class was generated from the following file:

- include/sampler.hh

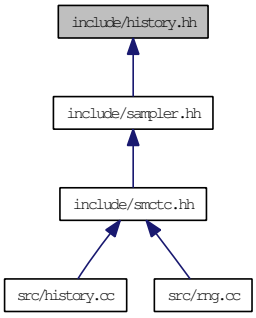
Chapter 7

File Documentation

7.1 include/history.hh File Reference

Classes and function related to the history of the sampler.

This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc
- namespace std

Classes

- class smc::historyflags

  The historyflags class holds a set of flags which describe various properties of the particle system at a given time.

- class smc::historyelement< Particle >

  A template class for the elements of a linked list to be used for the history of the sampler.

- class smc::history< Particle >

  A template class for the history associated with a particle system evolving in SMC.

Defines

- #define __SMC_HISTORY_HH 1.0

Functions

- template<class Particle>
  ostream & std::operator<< (ostream &os, smc::history< Particle > h)

  This function will ultimately allow the standard stream operators to be used to display a particle history in a human readable form.

7.1.1 Detailed Description

Classes and function related to the history of the sampler.

This file contains template definitions for the classes used to store the history of an SMCTC sampler. It defines smc::history, smc::historyelement and smc::history.

Definition in file history.hh.

7.1.2 Define Documentation

7.1.2.1 #define __SMC_HISTORY_HH 1.0

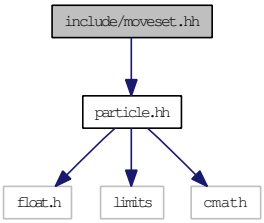
Definition at line 28 of file history.hh.

7.2 include/moveset.hh File Reference

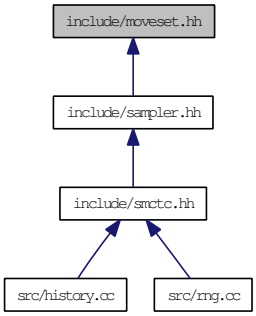
Classes and functions which deal with collections of sampler proposal "moves".

```
#include "particle.hh"
```

Include dependency graph for moveset.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc

Classes

- class smc::moveset< Space >

  A template class for a set of moves for use in an SMC samplers framework.

Defines

- #define __SMC_MOVESET_HH 1.0

7.2.1 Detailed Description

Classes and functions which deal with collections of sampler proposal "moves".

This file contains definitions of smc::moveset. It deals with the collections of proposal moves (including initialisation and MCMC moves) which must be dealt with by the sampler.

Definition in file moveset.hh.

7.2.2 Define Documentation

7.2.2.1 #define __SMC_MOVESET_HH 1.0

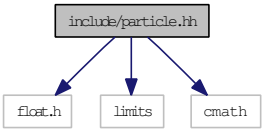
Definition at line 28 of file moveset.hh.

7.3 include/particle.hh File Reference

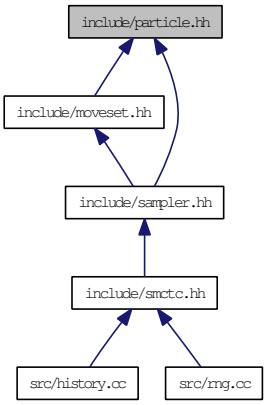
Class used to store and manipulate a single particle.

```
#include <float.h>
#include <limits>
#include <cmath>
```

Include dependency graph for particle.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc
- namespace std

Classes

- class smc::particle< Space >

  A template class for the particles of an SMC algorithm.

Defines

- #define __SMC_PARTICLE_HH 1.0

Functions

- template<class Space>
  std::ostream & std::operator<< (std::ostream &os, smc::particle< Space > &p)

  Produce a human readable display of an smc::particle class using the standard stream operators.

7.3.1 Detailed Description

Class used to store and manipulate a single particle.

This file contains the smc::particle class which is used internally and passed to move functions.

Definition in file particle.hh.

7.3.2 Define Documentation

7.3.2.1 #define __SMC_PARTICLE_HH 1.0

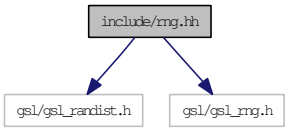
Definition at line 27 of file particle.hh.

7.4 include/rng.hh File Reference

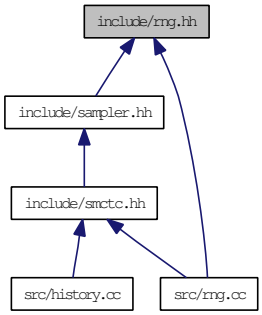
Random number generation.

```
#include <gsl/gsl_randist.h>
#include <gsl/gsl_rng.h>
```

Include dependency graph for rng.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc

Classes

- class smc::gslrnginfo

  A gsl-rng information handling class (not templated).

- class smc::rng

  A random number generator class.

Defines

- #define __SMC_RNG_HH 1.0

Variables

- gslrnginfo smc::rngset

  The global application instance of the gslrnginfo class:.

7.4.1 Detailed Description

Random number generation.

This file contains the definitions for the smc::rng and smc::rnginfo class. It wraps the random number generation facilities provided by the GSL and provides a convenient interfaces to access several of its more commonly-used features.

Definition in file rng.hh.

7.4.2 Define Documentation

7.4.2.1 #define __SMC_RNG_HH 1.0

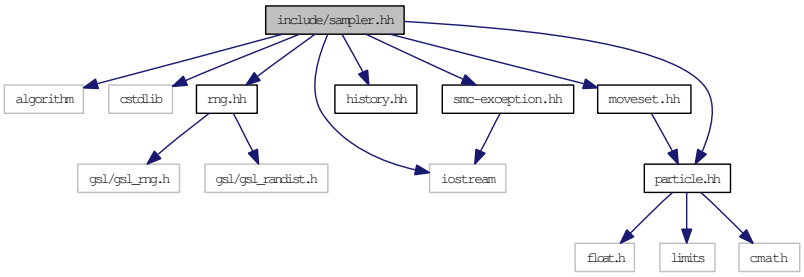
Definition at line 28 of file rng.hh.

7.5 include/sampler.hh File Reference

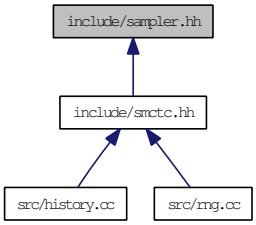
Defines the overall sampler object.

```
#include <algorithm>
#include <cstdlib>
#include <iostream>
#include "rng.hh"
#include "history.hh"
#include "moveset.hh"
#include "particle.hh"
#include "smc-exception.hh"
```

Include dependency graph for sampler.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc
- namespace std

Classes

- class smc::sampler< Space >

  A template class for an interacting particle system suitable for SMC sampling.

Defines

- #define __SMC_SAMPLER_HH 1.0

Enumerations

- enum ResampleType { SMC_RESAMPLE_MULTINOMIAL = 0, SMC_RESAMPLE_RESIDUAL, SMC_RESAMPLE_STRATIFIED, SMC_RESAMPLE_SYSTEMATIC }

  Specifiers for various resampling algorithms:.

- enum HistoryType { SMC_HISTORY_NONE = 0, SMC_HISTORY_RAM }

  Storage types for the history of the particle system.

Functions

- template<class Space>
  std::ostream & std::operator<< (std::ostream &os, smc::sampler< Space > &s)

  Produce a human-readable display of the state of an smc::sampler class using the stream operator.

7.5.1 Detailed Description

Defines the overall sampler object.

This file defines the smc::sampler class which is used to implement entire particle systems.

Definition in file sampler.hh.

7.5.2 Define Documentation

7.5.2.1 #define __SMC_SAMPLER_HH 1.0

Definition at line 27 of file sampler.hh.

7.5.3 Enumeration Type Documentation

7.5.3.1 enum HistoryType

Storage types for the history of the particle system.

Enumerator:

SMC_HISTORY_NONE

SMC_HISTORY_RAM

Definition at line 46 of file sampler.hh.

7.5.3.2 enum ResampleType

Specifiers for various resampling algorithms:.

Enumerator:

SMC_RESAMPLE_MULTINOMIAL

SMC_RESAMPLE_RESIDUAL

SMC_RESAMPLE_STRATIFIED

SMC_RESAMPLE_SYSTEMATIC

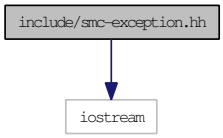
Definition at line 40 of file sampler.hh.

7.6 include/smc-exception.hh File Reference

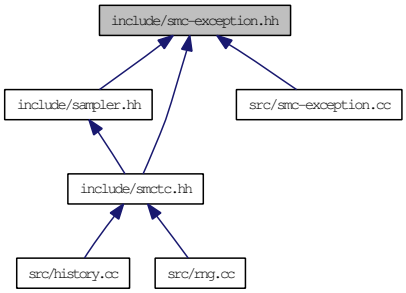
This file defines exception-handling facilities.

`#include <iostream>`

Include dependency graph for smc-exception.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc
- namespace std

Classes

- class smc::exception

  SMC Exception class.

Defines

- #define __SMC_EXCEPT_HH 1.0
- #define SMC_EXCEPTION(code, error) smc::exception(__FILE__, __LINE__, code, error)

  A macro which autocompletes the housekeeping components of an smc::exception.

- #define SMCX_FILE_NOT_FOUND 0x0020

  Exception thrown if a file cannot be accessed.

- #define SMCX_MISSING_HISTORY 0x0010

  Exception thrown if the sampler attempts to access history data which wasn't stored.

- #define SMCX_MULTIPLE_INSTANTIATION 0x1000

  Exception thrown if an attempt is made to instantiate a class of which a single instance is permitted more than once.

Functions

- std::ostream & std::operator<< (std::ostream &, smc::exception &)

  Produce a human-readable display of the state of an smc::exception class using the stream operator.

7.6.1 Detailed Description

This file defines exception-handling facilities.

The smc::exception class, which is used for exception handling by SMCTC, is defined.

Definition in file smc-exception.hh.

7.6.2 Define Documentation

7.6.2.1 #define __SMC_EXCEPT_HH 1.0

Definition at line 26 of file smc-exception.hh.

7.6.2.2 #define SMC_EXCEPTION(code, error) smc::exception(__FILE__, __LINE__, code, error)

A macro which autocompletes the housekeeping components of an smc::exception.

Definition at line 31 of file smc-exception.hh.

Referenced by smc::sampler< Space >::IntegratePathSampling(), and smc::sampler< Space >::IterateBack().

7.6.2.3 #define SMCX_FILE_NOT_FOUND 0x0020

Exception thrown if a file cannot be accessed.

Definition at line 34 of file smc-exception.hh.

7.6.2.4 #define SMCX_MISSING_HISTORY 0x0010

Exception thrown if the sampler attempts to access history data which wasn't stored.

Definition at line 36 of file smc-exception.hh.

Referenced by smc::sampler< Space >::IntegratePathSampling(), and smc::sampler< Space >::IterateBack().

7.6.2.5 #define SMCX_MULTIPLE_INSTANTIATION 0x1000

Exception thrown if an attempt is made to instantiate a class of which a single instance is permitted more than once.

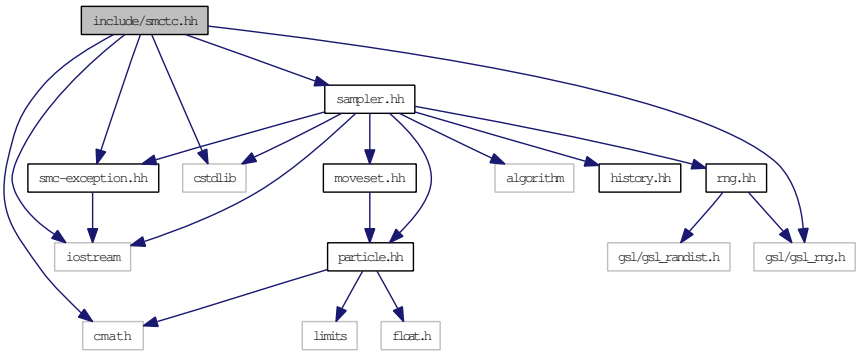
Definition at line 38 of file smc-exception.hh.

7.7 include/smctc.hh File Reference

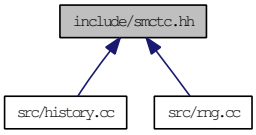
The main header file for SMCTC.

```
#include <cmath>
#include <cstdlib>
#include <iostream>
#include <gsl/gsl_rng.h>
#include "smc-exception.hh"
#include "sampler.hh"
```

Include dependency graph for smctc.hh:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace smc
- namespace std

Defines

- #define __SMC_TDSMC_HH 1.0

7.7.1 Detailed Description

The main header file for SMCTC.

This file serves as an interface between user-space programs and the SMCTC library. This is the only header file which applications need to include to make use of the library (it includes such additional files as are necessary).

Definition in file smctc.hh.

7.7.2 Define Documentation

7.7.2.1 #define __SMC_TDSMC_HH 1.0

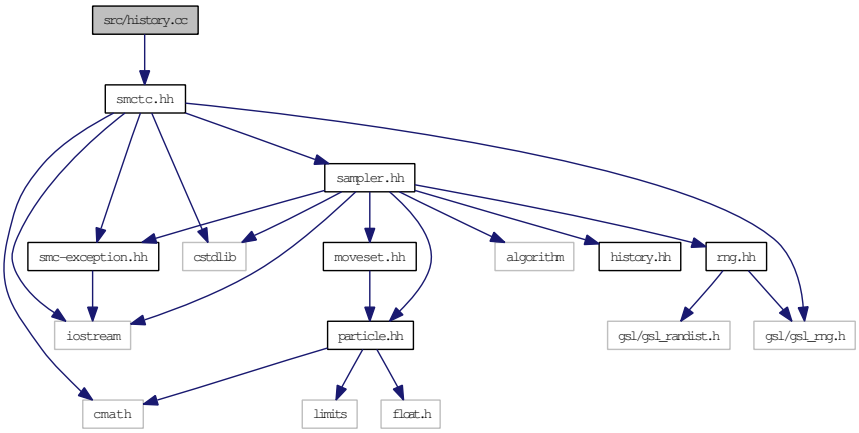
Definition at line 95 of file smctc.hh.

7.8 src/history.cc File Reference

This file contains the untemplated functions used for storing the history of the system.

```
#include "smctc.hh"
```

Include dependency graph for history.cc:



Namespaces

- namespace smc

7.8.1 Detailed Description

This file contains the untemplated functions used for storing the history of the system.

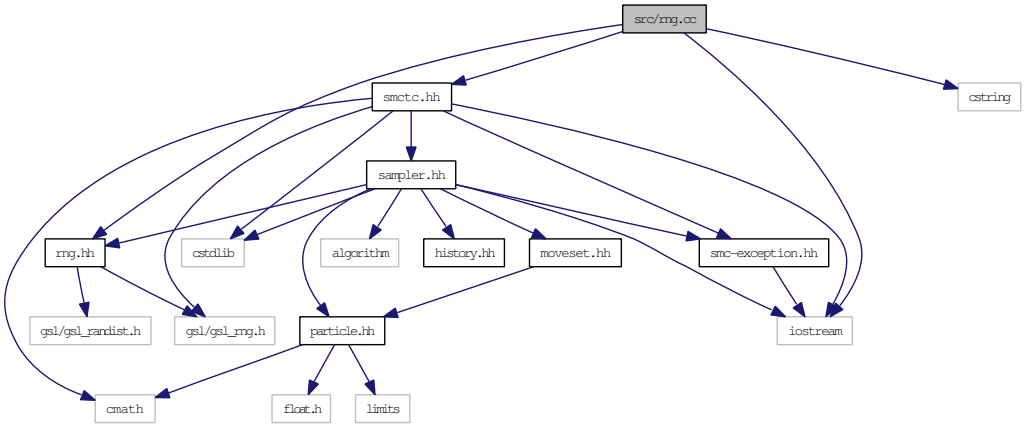
Definition in file history.cc.

7.9 src/rng.cc File Reference

This file contains the untemplated functions used for dealing with random number generation.

```
#include <iostream>
#include <cstring>
#include "rng.hh"
#include "smctc.hh"
```

Include dependency graph for rng.cc:



Namespaces

- namespace smc

7.9.1 Detailed Description

This file contains the untemplated functions used for dealing with random number generation.

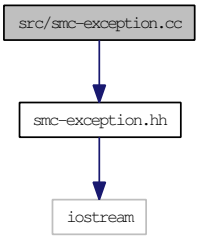
Definition in file rng.cc.

7.10 src/smc-exception.cc File Reference

The untemplated smc::exception class is implemented here.

```
#include "smc-exception.hh"
```

Include dependency graph for smc-exception.cc:



Namespaces

- namespace smc
- namespace std

Functions

- std::ostream & std::operator<< (std::ostream &, smc::exception &)

  Produce a human-readable display of the state of an smc::exception class using the stream operator.

7.10.1 Detailed Description

The untemplated smc::exception class is implemented here.

Definition in file smc-exception.cc.

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