Extension on Interactive Empirical Modelling of Aircraft Simulation

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Abstract

In this paper, I will improve the interactive simulation case designed with definitive notation and interactive principles of the Empirical Modelling. The DCS student of University of Warwick has developed a simulation model of aircraft by Empirical Modelling. So I need to add some new interesting functions to the model. In the computer science, building an accurate model and observing objects exist in the real world play a really important role in related research field. Empirical Modelling is a good way to build an experiential and exact interactive environment. With the Empirical Modelling, I can build and make simulation in the experiment, and use the experience to model the unknown iteration and situations. In the aircraft simulation, I will extend the more circumstances such as how the wind impacts on the aircraft, demonstrating the track of flight, how the aircraft turns Left/Right. These functions are lack in previous model. Based on the Empirical Modelling, constructing a real world situation becomes easier, the visual part of simulation is programmed in Scout and Donald, e.g. Aircraft Body, steering, meters, and the core functions will be implemented in the Eden, e.g. Record the tracks, count speed, detect changes of environment, departure, arrive. All interaction could be presented and constructed in the Empirical Modelling. Observables, dependencies, agencies will be emphasis in this model. In following paper, I will present observables, dependencies, agencies in my improved model based on the previous model which simulated the aircraft interaction and show how Empirical Modelling principles are used in the this model.

1 Introduction

In this section, the background and related knowledge will be addressed. .

1.1 Background

The Empirical Modelling, which is known as EM, is one kind of approach for the model building based on the concepts of observation, dependency and agency. The aim of EM is to build a realistic and accurate environment to demonstrate the interaction among observable, dependency and agency. The interactive environment owns the features such as open feature and experiential feature. Hence, the EM mainly exploits the computer for pre-theory experiment which uses experience to model unknown interactions and un-well known understood situations. (Interactive Empirical Model Design Simulation of Aircraft, 2007). The EM uses the definitive notation to model the issues from the real world. The EM definitive notation contains three parts, they are respectively Donald, Scout, and the Eden. The Donald takes responsibility for 2D line drawing, Scout is used to set up the screen layout, and the Eden is a general- purpose language which supports the definitive notations. However, the main interpreter is tkeden that provides conversion of statement from Scout and Donald to Eden definition before being interpreted.

1.2 Model

The original model, which is called Interactive Empirical Model of Aircraft simulation and developed by student of university of warwick, mainly simulates the interaction of aircraft wings and tail when the aircraft is flying in the sky. In the process of simulation, the model demonstrates the details that how wings and tail work if the aircraft changes the direction. However, the model looks like a static image.

Based on the original model, the goal of the extension is to explore the situation that aircraft faces the windy problems when it is moving in the sky. The model will work out the effect the wind has on the flight. Certainly, the model will be built in a dynam-

ic environment so that the aircraft can move like a real plane.

2 Simulation

2.1 Motivation

The extended simulation of aircraft represents more interaction with EM. The model simulates different kinds of behaviors that abide by the flying principles and allow the aircraft flies underlying these behaviors. In addition, the EM model provides a interface that allows the simulated aircraft to be interacted for the investigation of its behaviors. The situations simulated by EM model go as follow:

- The aircraft can move in a specific space like a real plane..
- On left corner, there are some meters that show the status of aircraft, such as speed, wind direction and operation status.
- When the "take off" button is clicked, the aircraft starts to move.
- The aircraft can change its direction by clicking the button "turn left" or "turn right".
- When the aircraft turns left or turns right, the wings and tail of the aircraft work like the original model.
- When the aircraft lands, the flaps are open to slow down the speed and tail become straight.
- There are eight directions where the wind will blow, they have impact on the direction and speed of the aircraft which is taken off from the airport.
- The wind also has affection when the aircraft turn lefts or turns right
.

Because EM model simulates the realistic problem so that some constraints will be set up during the simulation process.

- When the "take off" button is clicked , it means the aircraft start to departure, so the "take off" behavior cannot be activated again
- When the "landing" button is clicked, all operations are not allowed to execute.
- The wind direction influences the aircraft only if the aircraft departures.

In the model, different colors stand for different meaning. Generally, the green color means allowed operation and red color means that not allowed operation or warning. Yellow means the the wind operations are allowed.

The "reset" button is used to clear all data and initialize the model.

2.2 Behaviours

The behaviors simulated by EM model are described as follow:

Table 1. Logic for simulated aircraft (Interactive Empirical Model Design Simulation of Aircraft, 2007)

	Left flap	Right flap	Tail	Air flow
Take off	Close	Close	Straight	L = R
Turn left	Close	Open	Right	L > r
Turn right	Open	Close	Left	l < R
Landing	Open	Open	Straight	l = r
Reset	Close	Close	Straight	Invisible

Table 2. Wind effect for simulated aircraft

	Go straight	Turn left	Turn Right
West	none	Slower	Faster
East	none	Faster	Slower
North	Slower	none	none
South	Faster	None	none
WestNorth	Slower	Slower	Faster
WestSouth	Faster	Slower	Faster
EastNorth	Slower	Faster	Slower
EastSouth	Faster	Faster	Slower

3 Empirical Model Design

3.1 Observables

The observables are the entities that construct the model. The observables play important role in the establishment of EM model. The EM set a dependency between two observables. In extended simulation of aircraft, the observable are such as the tail, flap, and speed of aircraft.

3.2 Dependencies

The dependency is a relationship between two observables. The dependency connects one observable to the other so that one changes, the other changes. It is used to express the affection on the values of observables. Therefore, dependency is complicated interactive systems different from a group of individual parts. (Interactive Empirical Model Design Simulation of Aircraft, 2007) In this model, the dependencies are such as the relationship between the speed and the wind direction, the tail and the flaps.

3.2 Agencies

The agency is one kind of the observable. It can be used to change the values of other observables. If the EM model requires interaction among observables and dependencies, the agencies will generate this interaction. The agency is very useful for human-computer interaction in EM model. In this model, agencies are such as operation to turn left, turn right, and the wind buttons change the speed and directions of the aircraft.

4   Future Work and Conclusion

4.1   Future Work

This model has been built up successfully. Most of functions work well and no bugs occur. However, some new features should be considered to add in the future work.

- Add a rainy day situation, simulate how the aircraft overcomes the rain problem when it goes through the rain cloud.

- Make the aircraft be able to do more action such as turn around, shake and tilt.

- Simulate the situation that aircraft departures and arrives. The speed rises up or slows down second by second.

- Change the aircraft shape so that make it more look like a real aircraft.

4.2   Conclusion

This paper introduces the background of Empirical Modelling and related knowledge about the "Interactive Empirical Model Design Simulation of Aircraft" model. The terms of observables, dependencies, agencies are explained in specific part of this paper. The definitive notation is also introduced. The extension of simulation of the aircraft demonstrates that the Empirical Modelling is able to build up a realistic, open, experiential environment for solving the problems from real world.

Acknowledgements

References

Interactive Empirical Model Design Simulation of Aircraft, 2007, Department of Computer Science , University of Warwick.

Appendix

Figure 1. Ready

Figure 2. Take Off

Figure 3. East Wind