Agent Oriented Requirement Engineering for Lake Mathematical Modelling: Preliminary Study

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Abstract— **Agent oriented requirement engineering (AORE) is useful in transforming mathematical models to agent oriented modelling and simulation. The transformation process is based on a requirement elicitation study in which various stakeholders will understand users' requirements through elicitation questions and interviews. The AORE enable the modellers to understand the mathematical model and translate the model into the agent context. With AORE, the computational science students can enjoy the benefits of agent modelling and simulation during their study. This paper presents the work to guide the computational science and mathematical students in agent based simulation. It presents a method to transform the discrete mathematical model into individual based modelling and simulation. Consequently, the method is able to promote the agent technology to a wider audience. We proposed an extended version of AORE that can offer requirements elicitation support in environmental modelling, a computational science (CS) domain of study. The mechanism of AORE within a state of the art agent oriented methodology (AOM) is presented in details through a lake modelling case study in this paper. Also, a demonstration on simulating the case study in agent simulation, NetLogo, and comparison with the origin simulation results of lake model is elaborated to validate the feasibility of AORE.**

Index Terms— **Agent modelling; Agent simulation; Mathematical model.**

I. INTRODUCTION

Mathematical modelling is one of the major courses taught in Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak (UNIMAS). During the course, the students are taught on various mathematical topics like differential equation, multivariable calculus, linear algebra and so on. The core study of Computer Science (CS) is adopting math in problem solving. Hence, mathematical formulation is the fundamental knowledge of CS, while MATLAB and Maple are among the well know simulation tools among the CS lecturers and students. On the other hand, there is an active research on individual modelling and simulation through agent oriented modelling and simulation.

The intention to learn the agent modelling and simulation seems to be a non-trivial task. There is neither course in this study nor guidelines or methods to shape the mathematical model into agent context. In order to bridge the learning gap on agent modelling and simulation among the CS and mathematical students, we proposed to adopt Agent Oriented Methodology (AOM) in this research. AOM is introduced to model a complex socio-technical system. It adopts the agent paradigm to model and develop the complex system which involve human, hardware, network and software [1][8][9]. The agent paradigm introduces notion of goal, role, organization, domain knowledge, social, norm, interaction, behaviour, motivation. It has been widely adopted in the domain of manufacturing, intelligent system and robotic, games [7]. This paper presents the work to guide the computational science and mathematical students in agent based simulation. It presents a method to transform the discrete mathematical model into individual based modelling and simulation. Our hypothesis is that AOM is able to bridge the learning gaps in the area of agent modelling and simulation among the CS and mathematical students in University. Consequently, the method is able to promote the agent technology to a wider audience.

The adoption of Agent Oriented Requirement Elicitation (AORE) is reported in this paper. The mechanism of AORE is presented in details through a lake modelling case study in this paper. Also, a demonstration on simulating the case study in agent simulation, NetLogo, is elaborated to validate the feasibility of AORE. Indirectly, this further partially validates the usefulness of AOM methodology in complex software system modelling and simulation development.

Works have been done to propose a methodology for computational science development processes [3][4]. In the work of [4], the processes for mathematical modelling are identification of model starting points; formulate the problem; create model solution; verification of develop model. In line with the needs of a systematic way on mathematical modelling, we propose AOM as part of the computational science development process, especially in agent modelling and simulation.

Section two presents the motivation case study on this project. It covers the lake model elaboration in general. This is followed by the elaboration of the proposed AOM for agent oriented mathematical model in Section three. Section four presents the walkthrough example to transform the lake mathematical model into agent context through eHOMER. Then, the modeller can proceed to agent simulation through NetLogo. Section five presents the simulation of the lake model through agent simulation platform, NetLogo together with the simulation results. The paper is concluded in section six.