Special Issue: Highlighting the military modeling and simulation work at the Systems Modeling and Simulation Laboratory at KAIST

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Editorial

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Welcome to this special issue of *Journal of Defense Modeling and Simulation* on 'Highlighting the military modeling and simulation work at the Systems Modeling and Simulation Laboratory at KAIST', incorporating publications that reflect various stages of the military modeling and simulation field. The Systems and Modeling Simulation Laboratory (SMSLab) at KAIST has developed key theory and technology and has also applied the lab's product to real-world military systems. Recently, this research effort has been acknowledged by receiving the first Bernard P. Ziegler DEVS modeling and simulation award at the commercial discrete event system (DEVS) application track and the best paper award from the 2010 summer simulation multi-conference. This special issue focuses on such research activity in the lab and consists of four paper contributions: (1) the overall introduction of methodologies and tools developed at SMSLab; (2) the formal definition of measures of effectiveness and measures of performance for defense modeling and simulation analyses; (3) the interoperation of defense simulation models from heterogeneous abstraction layers; and (4) the statistical analyses of naval air defense operations at the mission level.

Kim et al. introduce the modeling and simulation framework that SMSLab has developed as well as applied to real-world examples. They build up a toolset from the DEVS formalism, so the produced toolset provides complete and verifiable specifications of the systems modeled. Also, specifications are highly compatible with other modeling and simulation tools with the formalism's virtue of transparency and standardization. With the firmly grounded theory basis, the toolset provides easy accesses to latest defense modeling and simulation technologies. For instance, DEVSimHLA, a tool from the DEVSim toolset, supports easy utilization of HLA/RTI technologies, a type of simulation interoperation standards and technologies, using models specified in the DEVS formalism. In addition, the authors identify the different demands from the field, and they provide corresponding tools to meet the need in different modeling and simulation stages, i.e. requirement analysis, model specification, model development, model interoperation, and model verification.

The paper from Hong and her colleagues formally suggests definitions of measures of performance and measures of effectiveness which are the analysis criteria for many defense modeling and simulation cases. This paper presents the interoperations of multiple models to obtain new insights into the measures at different abstraction levels. Existing simulation models are often developed to model a real-world problem at a pre-determined abstraction level, which limits interplays of features and parameters from different abstraction levels. Hence, the paper utilizes the interoperation between models at heterogeneous levels to feed outputs from lower abstraction level model to higher abstraction level model as input parameters, and vice versa. This interoperation approach provides new insights into how to setup, utilize and interpret input and output parameters between models at two levels.

Seo et al. present a case study of an anti-torpedo underwater warfare system. This paper assumes a warship versus a torpedo scenario, with very realistic movement and decoy models. This work is an example of how to specify a realistic combat model with the DEVS formalism. In particular, this paper focuses on the individual model behavior specification as well as the overall model composition specification. This work is a clear demonstration of developing a combat model at the engineering and tactical level.

The last paper from Kim and his colleagues describes a detailed modeling of a naval air defense scenario with multiple friendlies and multiple opponent forces. The

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presented model incorporates a decision-making process at the mission-execution level, and the paper illustrates how to specify such decision-making process with the DEVS formalism. In addition, this paper describes a doctrine analysis process using the developed model and battle experiment designs. We expect that this paper would suggest a doctrine and field manual development process using the defense modeling and simulation framework.

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Author Biographies

Tag Gon Kim received his PhD in computer engineering with a specialization in systems modeling and simulation from University of Arizona, Tucson, AZ, 1988. He was an Assistant Professor at in the Electrical and Computer Engineering Department, University of Kansas, Lawrence, KS, from 1989 to 1991. He joined the Electrical Engineering Department, KAIST, Tajeon, Korea in Autumn, 1991, and has been a Full Professor at the EECS Department since Autumn, 1998. He was the President of The Korea Society for Simulation (KSS) and the Editor-In-Chief for *Simulation: Transactions of The Society for Modeling and Simulation International* (SCS). He is a co-author of the textbook *Theory of Modeling and Simulation* (Academic Press, 2000). He published about 200 papers in modeling and simulation theory and practice in international journals and conference proceedings. He is very active in research and education in defense modeling and simulation in Korea. He was/is a technical advisor for defense modeling and simulation at various Korean Government organizations, including the Ministry of Defence, Defence Agency for Technology and Quality (DTAQ), Korea Institute for Defence Analysis (KIDA), and Agency for Defence Development (ADD). He developed a toolset, called DEVSimHLA, for HLA-compliant war game models development, which has been used for the development of three military war game models for the Navy, Air Force, and Marines in Korea. He is a Fellow of the SCS, a Senior Member of IEEE, and Eta Kappa Nu.

Il-Chul Moon is a postdoctoral researcher at the Department of Electrical Engineering, KAIST. His research interests include social-network analysis, agent-based simulation and counter-terrorism, defense modeling, and simulation.