Minitrack: 'Modeling Nonlinear Natural and Human Systems"

Hans J. (Jochen) Scholl
University of Washington
The Information School
jscholl@u.washington.edu

George P. Richardson
University at Albany / SUNY
Rockefeller College of Public Affairs and Policy
gpr@albany.edu

Numerous natural and human-made systems can be described as nonlinear or complex. Such systems often escape the straight cause-effect and linear modeling patterns which traditional science has successfully used over centuries. Linear approximations of dynamic phenomena rarely deliver satisfactory results. On the other hand, nonlinear modeling techniques became feasible and more popular only with the advent of the digital computer some fifty years ago and have been widely used for little more than a decade and a half. In other words, even though the theoretical foundations were laid out much earlier, practical research and application of nonlinear modeling are still in their infancy compared with linear modeling.

Among the traditional approaches to modeling nonlinear and dynamic systems are techniques such as discrete event simulation or Markov chains. System dynamics (SD), which captures and analyzes the feedback structure of complex dynamic systems, and agent-based modeling (ABM), which focuses on the rule-based emergent behavior of interacting individual agents, are two other prominent modeling techniques. Multi-method approaches, dynamic triangulation, and complementary applications of these modeling techniques in terms of an integrated research design have been proposed before [1-3]. Integrated designs are still rare and have only emerged recently. This minitrack acts as a forum for bringing together nonlinear systems modelers of various backgrounds with the ultimate aim of exploring the prospects and benefits of integration through better understanding of each technique's research design potential. The insights from integrated research will certainly be relevant and beneficial not only to academic research but also to managerial practice and decision making.

The first paper in the minitrack's first of two sessions, entitled "*Optimal Decision Making in a Dynamic Model of Poor Community Health"* by Jack Homer and Bobby Milstein, presents simulation results of a dynamic model of a hypothetical community in poor health conditions, which incorporates a systemic perspective on disease control based on the concept of causal feedback

The second paper authored by Amituva Dutta and Rahul Roy under the title of "*Internet diffusion in India and China: Comparison based on feedback loop dominance*" employs a system-dynamics perspective when studying differences and commonalities of Internet proliferation in those two most populous countries. The authors recommend policy choices, which favor a balanced approach to infrastructure expansion and sectoral absorption of Internet technology.

The third paper, entitled "*Knowledge and the development of interpersonal trust: A dynamic model*" by Luis Luna-Reyes, Anthony M. Cresswell, and George P. Richardson presents a theory-building study based on a system dynamics model. The study integrates various contributing theories with longitudinal case study data demonstrating the relationship between collaborative knowledge generation and collaborators' mutual trust.

The fourth paper (presented in the second session of this minitrack) by Henk Akkermans entitled "*Opportunism versus Partnership Orientation in Buyer-Supplier Relationships: An Agent-Based Modeling Study of High-Tech Supply Network Dynamic"* studies the dynamic behavior of agents in a supply network ranging from purely opportunistic to purely partship-oriented.

The fifth paper by Wayne Wakeland, Edward Gallaher, and Louis Makovsky under the title "*A Comparison of System Dynamics and Agent-Based Simulation Applied to the Study of Cellular Receptor Dynamics"* demonstrates the application of a system-dynamics and agent-based modeling approach advocated by this minitrack.

The concluding paper by Hans J (Jochen) Scholl entitled "*Action Research and Systems Dynamics: Can they benefit from each other?*" makes the case for embedding the group model building approach in system dynamics into an Action Research approach benefiting both model utility and the overall researcher/practitioner confidence in the research outcomes.

References

[1] S. E. Phelan, "A note on the correspondence between complexity and systems theory," Systemic Practice and Action Research, vol. 12, pp. 237-246, 1999.

[2] H. J. Scholl, "Agent-based versus systems dynamics modeling: A call for cross study and joint research," presented at 34th Haiwaiian International Conference on System Sciences, Maui, HI, 2001.

[3] H. J. Scholl, "Looking Across the Fence: Comparing Findings From SD Modeling Efforts With those of Other Modeling Techniques," presented at 2001 Annual International Conference of the System Dynamics Society, Atlanta, GA, 2001.