Minding the Cyber-Physical Gap: Modeling Reality vs. its Perception by Systems with OPM

The cyber-physical gap (CPG) is the conceptual gap between reality and its representation by systems that must react to it. Affecting lives of humans around the globe, CPG is a critical consideration in modern systems engineering and operation. As the model-based systems engineering (MBSE) paradigm is gaining traction, conceptual modeling frameworks still focus on the nominal system model, hardly accommodating disruptive impacts, such as risk and CPG, and their potential adverse effects. Focus on nominal scenarios requires costly maintenance, coordination, and integration of such extraneous satellite models with the "main" nominal model. This results in loss of information, inconsistency, and contradiction. To solve this problem, we propose an Object – Process Methodology (OPM) - based modeling pattern that captures CPG. Detecting CPG, this pattern enables modeling agent-conceived anomalies and mitigation paths to prevent or minimize adverse impacts of wrong system decisions and actions on the system and its environment. This approach significantly increases the reliability and utility of the model and the robustness of the resulting system. We present the value of this approach by its application to several cases, including the Three Miles Island 2 nuclear accident, airport operations, and ballistic missile defense *(joint work with Professor Dov Dori).*

Biography:

Yaniv Mordecai has defended his PhD thesis in systems engineering at the Technion – Israel Institute of Technology, Haifa, Israel, under the supervision of Prof. Dov Dori. Yaniv holds MSc (2010, cum laude) and BSc (2002) degrees in industrial engineering from Tel-Aviv University, Tel-Aviv, Israel. His research interests include model-based systems engineering, cybernetics, risk analysis, decision analysis, interoperable systems, and operations research. He is a proficient and active systems engineer, with expertise in aerospace and defense, information technology, command and control, and avionics systems. During his PhD studies he has published several journal and conference papers (including papers for INCOSE IS 2013, 2014, and 2016), won more than 10 awards and grants, and acted as a manuscript reviewer for INCOSE Systems Engineering Journal, IEEE Transactions on Systems, Man, and Cybernetics, and Springer