Challenge Team

Augmented Intelligence in Systems Engineering

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What is Augmented Intelligence?

• How normal human intelligence is supplemented through the use of technology, such as artificial intelligence (AI) and machine learning (ML)

• An approach that promotes “team play” of human and machine intelligence, where performance of team is greater than the AI or human individually
Augmented Intelligence (AuI) in SE Challenge Team Charter

• Charter
  – Effectively pair human and machine intelligence to improve systems engineering
  – Goal: Further the understanding of how computational approaches, such as artificial intelligence, machine learning, and data science, can collaborate with human systems engineers to measurably improve the system engineering effort. The challenge team will seek out approaches that enhance human capabilities in systems engineering.
  – Chartered Feb 2018
    • http://www.omgwiki.org/MBSE/doku.php?id=mbse:augmented

• Activities
  – Conceptual Model of Augmented Intelligence
  – Presentations (GVSETS, GLRC, NMWS)
  – White Paper (GVSETS)
  – Poster Boards Discussions (MIT LL)
Human vs AI Competitions

What is Toronto?

ITS LARGEST AIRPORT IS NAMED FOR A WORLD WAR II HERO; ITS SECOND LARGEST, FOR A WORLD WAR II BATTLE

IBM Watson

AlphaGo
Chess: Human vs AI

Computer Chess

- Best human play
- 1st Win AI
- Last Win Human

Chess: Human vs AI
Freestyle Chess

Rules: \{

Human + Machine = Centaur

0..n + 0..n = 0..n


Q: What makes for a great freestyle operator?

**KASPAROV:** Someone who can work out the most effective combination, bringing together human and machine skills. I reached the formulation that a weak human player plus machine plus a better process is superior, not only to a very powerful machine, but most remarkably, to a strong human player plus machine plus an inferior process.

**Kasperov’s Law:**

Weak Player + AI + Good Relationship

*Outperforms*

Strong Player + AI + Inferior Relationship
AI in Systems Engineering

Conceptual Model

The ISO/IEC 15288 processes and lifecycle stages

System 1: AI embedded in target system / target environment
Trust Relationship: AI will perform reliably and predictably under anticipated conditions, and will gracefully degrade when unable to perform tasks.

System 2: AI as a collaborator in the system lifecycle processes for System 1
Trust Relationship: Models & AI will provide unbiased insights into patterns expressed by data, and assist the engineering team in applying learned patterns, in a manner than improves the technical and operational aspects of systems engineering.

System 3: AI as a co-manager for cross-domain efficiency, effectiveness and innovation for System 2
Trust Relationship: AI will enhance understanding and discovery to better communicate, collaborate, and share critical information about engineering processes in timely manner.

Source: INCOSE Agile Working Group
Activities

Conceptual Model for Augmented MBSE

ISO 15288 and SE Processes

Human Centered Design: Rules of Algorithm

Algorithmic Design

Case Studies
Challenge Team Goals

Goal 1: Develop a conceptual framework for AuI
Goal 2: Develop history of how we collaborate / interact with models
Goal 3: Define what is “under control of model”
Goal 4: Define what AuI means in a SE process
Goal 5: How to introduce learned information to SE process
Goal 6: Develop an example
Goal 7: Case Studies
Goal 8: Current State of Art
History

• Challenge Team Started, February 2018
• Presentation: Augmented Intelligence: Combining Model Based Systems Engineering with AI & Machine Learning, 2018 No Magic World Symposium, May 2018
• Presentation: Augmented Intelligence for Systems Design, 2018 INCOSE Great Lakes Regional Conference, August 2018
• Presentation & Paper: Implementing Augmented Intelligence In Systems Engineering, 2018 NDIA Ground Vehicle Systems Engineering and Technology Symposium (GVSETS), August 2019
• Poster Board Discussion: Forming Effective Human/AI Engineering Teams, MIT Lincoln Labs, Poster Presentation, November 2018
• Workshop, INCOSE IW, January 2019
Research Questions

• Model Interactions
  – How do humans interact with models and model-generated information?
  – How do humans interact with each other using models?
  – What cognitive challenges exist for model-informed decision-making?
  – What are essential human roles in model-centric environments?
  – How can interactivity of humans and models be made more effective?

• Trust
  – How to maintain trust relationships in a Digital Engineering environment with Model to Model interactions?

Posterboard Presentation, Human-Machine Collaboration for National Security Workshop, MIT Lincoln Labs
Invitation to Upcoming Workshop

• 26-29 January 2019 INCOSE International Workshop
  – Working session Monday 28 January, 11-12pm
• Open Discussion
  – Topics
    • Knowledge Representation
    • Learning and Applying Knowledge
    • Teaming Relationships
    • Communication and Visualization
    • Trust
    • Measures of Performance
    • …