SYSTEMS ENGINEERING RESEARCH CENTER

RT-183: Adaptive Cyber-Physical Human Systems

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Research Task / Overview

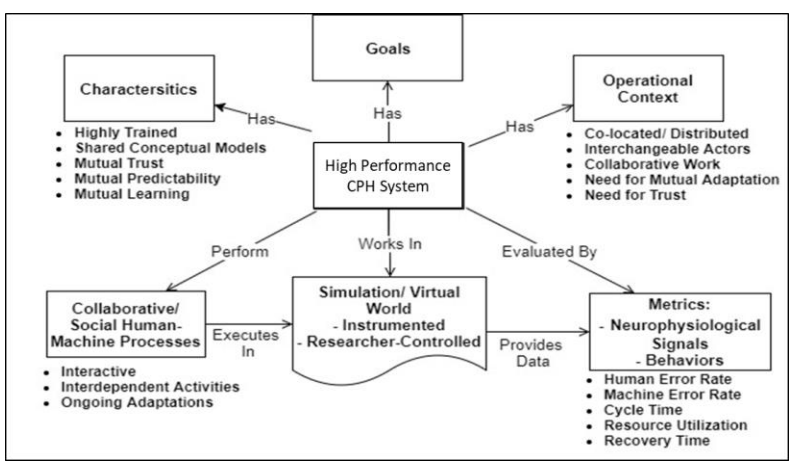
- Adaptive CPH systems have the ability to learn and adapt structure and organization based on data acquired from collection assets including its manned and unmanned nodes

Goals & Objectives

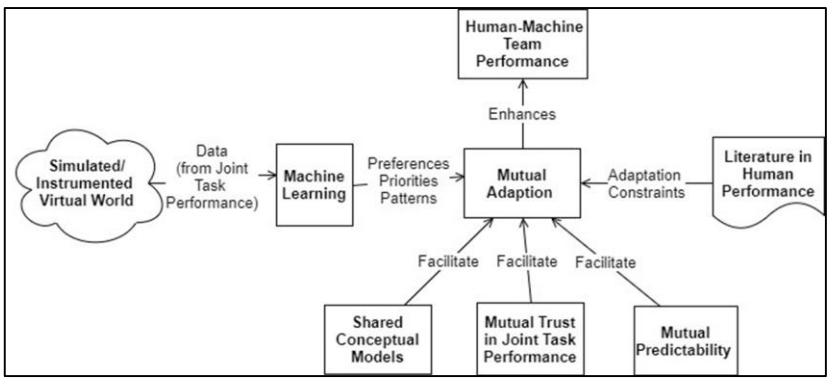
- Develop a probabilistic CPH modeling approach that supports mutual adaptation within the CPH system based on analysis of observations made by humans and data collected by cyber-physical elements
  - Create a probabilistic pattern structure and library that can become the basis for a future bidirectional decision system
  - Create the means by which human actors can adapt trained patterns and create new ones

Data & Analysis

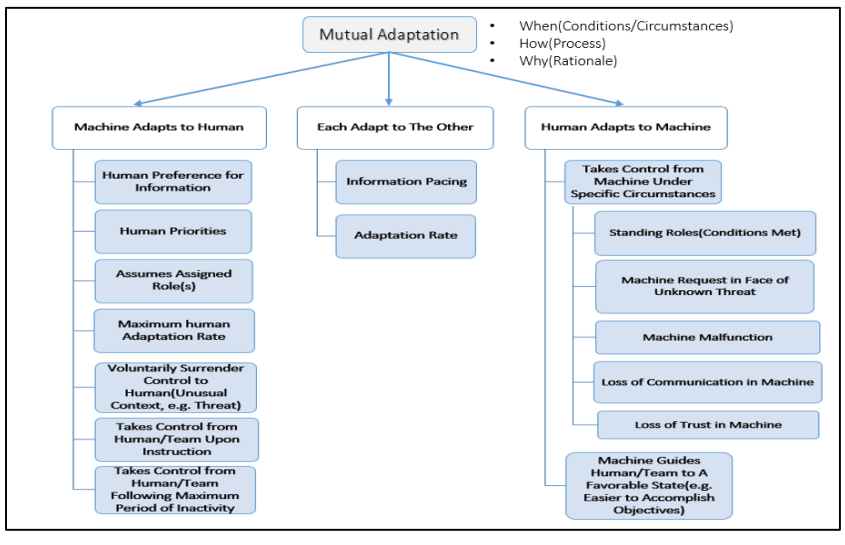
- High-Performance CPH System Schema



- Mutual Adaptation Schema



- Mutual Adaptation Facets



Methodology

- Key features:
  - In addition to determining the best probabilistic match to a given observation, we evaluate the "distance" from the observations comprising the best match to the current observation
  - If "distance" is small," then observation is a likely member of the pattern observation set
  - If "distance" is large, then observation may belong to a new pattern.
  - We let a human judge the results of analysis made by the pattern matching system, and trigger updates to existing patterns, or addition of new patterns.

Future Research

- Identify CPH system of interest to DOD
- Prototype CONOPS
  - Operational context
  - Sources of disruption
  - Need for mutual adaptation
- Refine Adaptation and Learning Concepts
  - Supervisory learning
  - Data sources
  - Data collection constraints

Contacts/References

- Madni, A.M., " Mutual Adaptation in Human Machine Teams," ISTI White Paper, Jan 11, 2017
- Madni, A.M. and Sievers, M. Model Based Systems Engineering: Motivation, Current Status and Needed Advances, accepted for publication in Systems Engineering, 2016