Pace: Modelling time and timing in joint Human-AI collaboration

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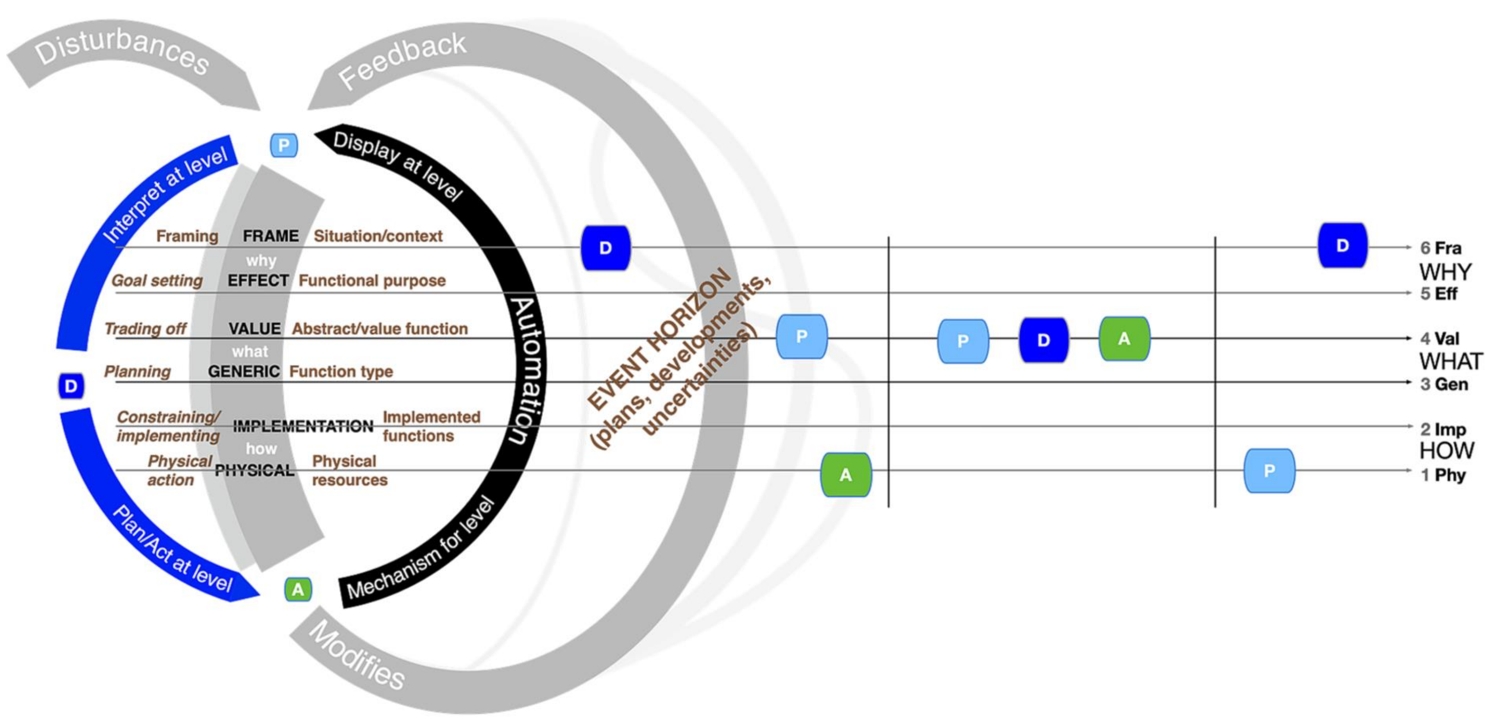
Motivation

In human-AI collaboration research, the aim is to include human operators in the often - fast-paced - machine decision-making loops. The goal is to improve **communication** between the human and the machine and to ensure that the human operator **retain overall control**. However, we see that time and timing can be a significant source of complexity since effective collaboration requires careful attention to issues such as response time, latency, and synchronization among actors in the joint human AI system.

Time, time and time again ⌛

Accomplish tasks takes **time**. Identifying the problem takes **time**. Understanding the problem takes **time**. Creating a solution takes **time**. Getting resources takes **time**. Doing the actual task takes **time**.

Specifically, research is needed on temporally-aware joint human-AI systems that can model, manage and resolve decision-time constraints on both human and the machine.



Modeling joint systems

The Joint Control Framework (JCF) will be used to model temporal decision-making and control processes from a cognitive (systems) engineering perspective [2]. The result is a machine-readable and temporal representation of the decisions and control actions of the operator, and the autonomous system used in the different scenarios.

This is later used for identification and development of needed time measurements and machine learning models (timers, decision time outs, time predictors etc).

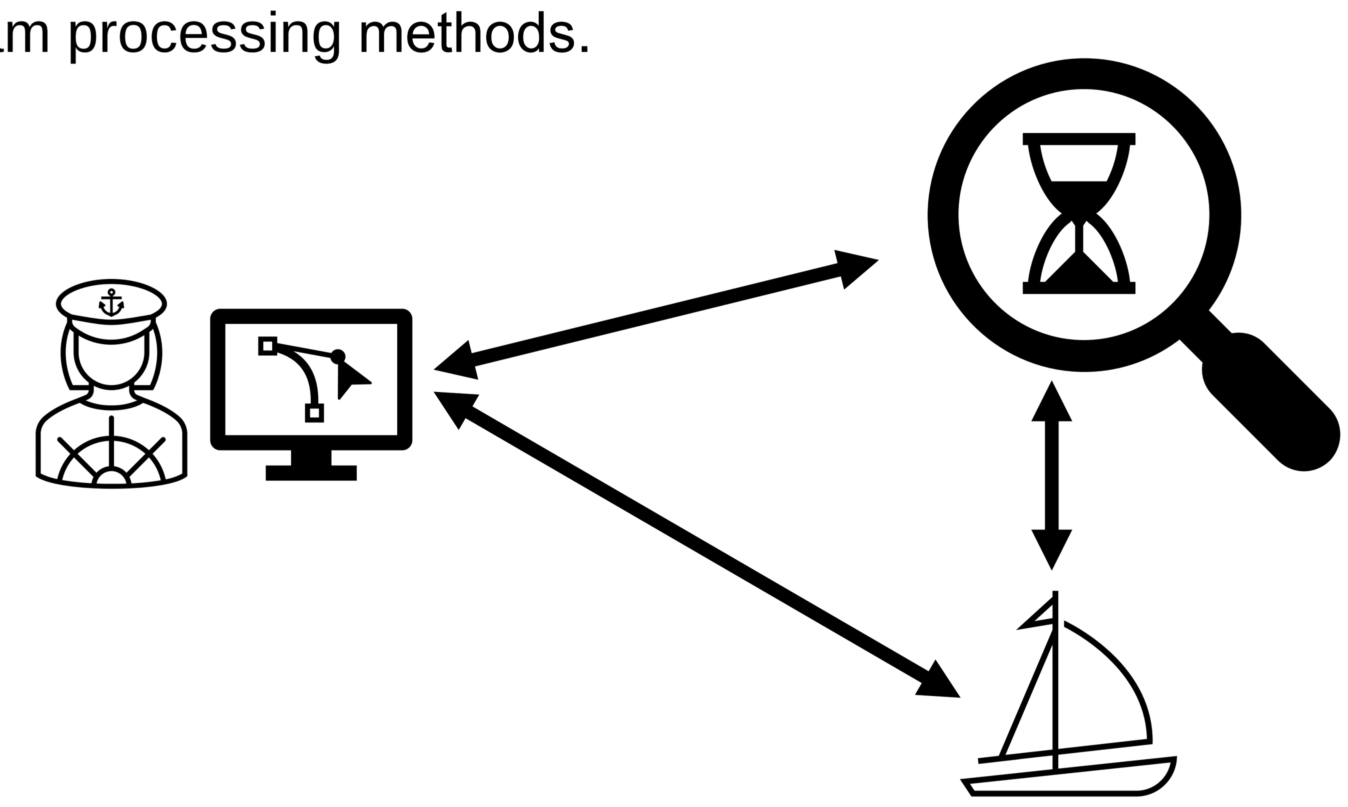
References

1. Hollnagel, E. and D. A. Woods (2005). Joint cognitive systems: foundations of cognitive systems engineering. Boca Raton, FL, CRC Press.
2. Lundberg, J. and B. J. E. Johansson (2021). "A framework for describing interaction between human operators and autonomous, automated, and manual control systems." Cognition, Technology & Work 23: 381–401.

Case

In this project, operators and their control process are tracked, as well as machine decision making. Collaboration with Saab Kockum’s is a perfect example for this project. Here, operators work together with autonomous vehicles in search and rescue scenarios. Kockum’s overall system architecture, the navigation control stack, is built upon joint cognitive system theory by Hollnagel and Woods[1], similar to the basis of this project.

Data collection regarding human perceptions and actions, as well as other psychophysiological variables, are conducted using eye tracking, screen capture, cameras et cetera. This will be processed with machine learning and distributed stream processing methods.



Progress

Empirical data has been collected with Kockums in a multi-agent maritime scenario with human operators supervising autonomous agents (Kockums Piraya). The data consisted of eye tracking data, human and automated control interactions, as well as radio (voice) communications between the human operators. The data has been analyzed, and the writing of a paper to present the results is ongoing.

Goal

An experimental platform will be created, where tests of hypotheses can be investigated. The platform will be able to create new scenarios to learn how to improve and streamline the decision-making process and make it more robust.

This platform will also result in a machine-readable language and classification of human decision-making activities and machine decision-making, along with their temporal constraints.

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