

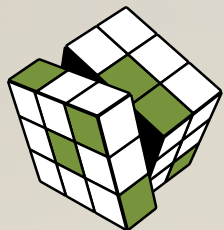


Towards Incorporating Cognitive Models in Applications

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Cognitive Modelling in dynamic Human-Maschine Systems

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WE CAN USE COGNITIVE MODELS TO

- ... develop and test theories of cognitive processing
- ... evaluate interfaces/tasks
- ... integrate cognitive models into technical systems to provide better understanding and collaboration between human and technical system

WHAT ARE THE PROBLEMS WE FACE CONCERNING NEW TECHNOLOGIES?



PROBLEMS AUTONOMOUS SYSTEMS SHOULD SOLVE

- People make mistakes and we want to avoid them.
 - Capacity limits
 - selectivity
 - Low effort mode / emergency program
 - "System degradation"
 - high workload/stress
 - Monotony, underchallenge
- Autonomy: relief/protection against overload and errors, efficiency
 - Unwanted effects:
 - "Dequalification" at the workplace
 - Monotony, fatigue
 - No understanding of the "larger picture"
 - Lack of practice and deskilling

INTELLIGENT SYSTEMS

- Even (semi-)autonomous systems make mistakes.
- What we need are systems that are able to work together with the user in a cooperative way.

- Anticipation

"The expectation of next events. Anticipating an event means taking into account that an event can occur."

HOW COULD AN OPTIMAL INTERACTION LOOK LIKE?

- Mutual anticipation of actions and goals (Hoffman & Breazeal, 2004; Knoblich & Jordan, 2003):
- Anticipating people - predicting mistakes
 - (e.g. resource limits, decisions, avoiding overstraining and understraining) offer meaningful support
- Design automation in such a way that it is easier to anticipate.
 - (e.g. less workload, less exploding communication, more security)

7 TO
UNDERSTAND
THE HUMAN IN
THE TASK
DYNAMICS



... with his/her skills



...and limits



... in order to design socio-
technical systems humane.

INTELLIGENT SYSTEM?



INTELLIGENT COGNITIVE ASSISTANCE



ANTICIPATION OF A USER / TECHNICAL SYSTEM

- What will the other person do?
 - What is the goal of the other person?
 - What is the next step towards the goal?
 - What does the other person need?
- What can I do myself?
 - Self-conception: What can I cause in my environment?
 - Learning from interaction with the environment (e.g. instance-based)

WHAT WE NEED ARE THREE KINDS OF MENTAL MODELS

- Mental Models of Tasks: How can I reach my goal by what kind of interactions? Learning through Interactions (Prezenski et al. 2017)
- Mental models of other people: What is this person doing next? What kind of information can this person have? What information was already processed? What mistake is this person about to do?
 - (Klaproth, Hallbrügge & Russwinkel “ACT-R model for cognitive assistance in handling flight deck alerts “ICCM 6, Sunday, 21/Jul/2019: 3:20pm - 4:40pm)
 - (Sebastian Wiese, Alexander Lotz and Nele Russwinkel “SEEV-VM:ACT-R Visual Module based on SEEV theory” ICCM 9: Monday, 22/Jul/2019: 3:20pm - 4:20pm)
 - (Preuss, Raddatz & Russwinkel “An implementation of Universal Spatial Transformative Cognition in ACT-R” Postersession)
 - (Scharfe & Russwinkel “Towards a Cognitive Model of the Takeover in Highly Automated Driving for the Improvement of Human Machine Interaction” Postersession)
- Mental Models of the Active Self: What can I achieve in my direct environment? What can I cause? What was caused by someone else? (Active Self Project)

INTELLIGENT COGNITIVE SYSTEM:

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- is based on a model approach of cognitive mechanisms.
- Additional parameters can describe the user, but also the context.
- Traces the user in real time.
- Provides support adapted to the situation and user state (temporal dynamics).

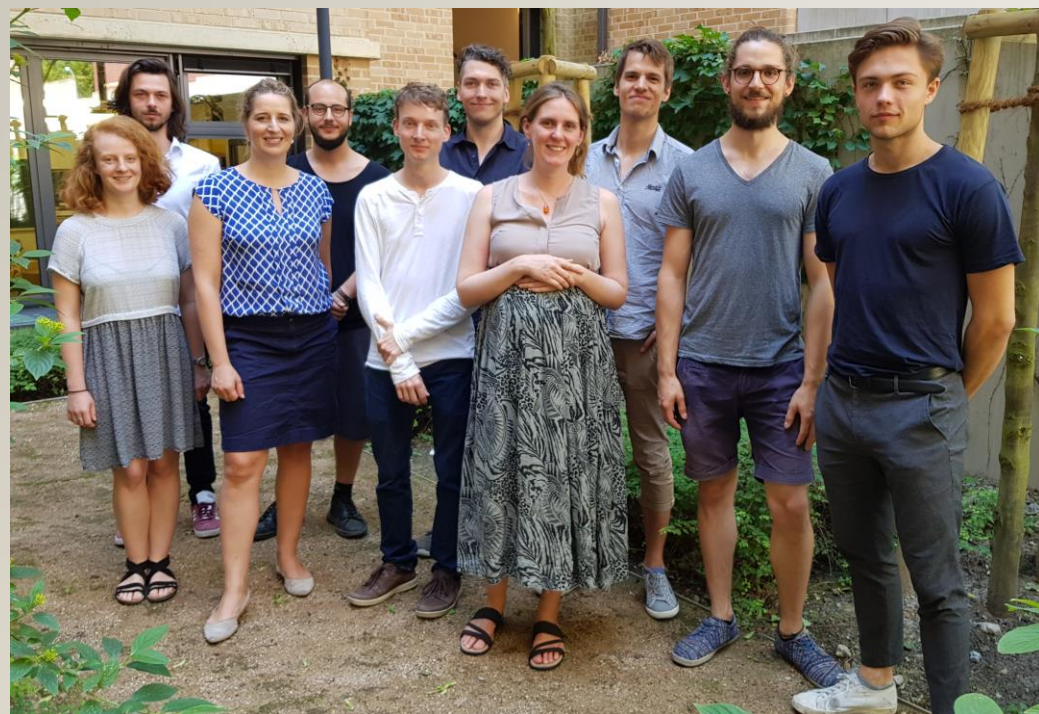
FAZIT

- For a meaningful interaction of humans and automation we need approaches for anticipation
 - This enables us to understand/anticipate the (semi-)autonomous system.
 - This enables the (semi-)autonomous system to understand/anticipate the human being.

→ An important step: to combine methods of cognitive and classical "artificial" intelligence.

DISCUSSION

- Cognitive architecture are well suited, e.g. because of system view – but what aspects are missing?
- More work on complex and interactive tasks would help (concentrate on most relevant aspects)
- Modelling individual differences is relevant
- Also Fokussing on „understanding“
- How could we validate or compare such models?



THANKS TO THE TEAM KMODYS!

THANK YOU FOR YOUR
ATTENTION!

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