Cognitive Systems Engineering:
New wine in new bottles

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Why Cognitive Study of Man-Machine Systems?

• Automation: from perceptual-motor skills to cognitive activities
• With code: machine is no longer purely mechanical \(\rightarrow\) information processor
• Human Factors, Engineering Psychology, Ergonomics fail to address cognitive functions
• (behaviorism \(\rightarrow\) no models only profiles 😞)

Old problems

• Designer – no model of operator’s cognitive functions

• Human behavior is psycho-logical (individual)
  – We are not calculus ratiocinator!!! (um I do I even have to say this?)

• Common: interface is frail but operator is a perfect

The whole and its parts

• Goal: “Improve the function of the system as a whole, rather than to replace as many operator functions as possible.”

System Performance

<table>
<thead>
<tr>
<th>% Automated</th>
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<tbody>
<tr>
<td>Low workload</td>
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<tr>
<td>High workload</td>
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100 80 60 40 20 0
What is a cognitive system?

- Result: “intelligent action”
- Behavior is **goal oriented**, based on **symbol manipulation** and uses **knowledge of the world** for **guidance**
- Operator’s model
- Machine’s image
- Common framework (same as talking)

Image levels

- Physical characteristics
- Cognitive processing capacity
- How two cognitive systems interact
- Total operational system
- Not explicitly but dynamic as appropriate

MMS descriptive levels

- Skill-based, rule-based, knowledge-based
  - Not the most important

Engineering?

(You mean do something with CS, wait I thought we were just talking?)

- Cognitive task analysis

**Fig. 1**: Cognitive systems engineering in the design process.
Man-Machine Principles

• Meta-guidelines
  – e.g. Field of attention and level of abstraction in human cognition

Evaluating
(naw if I say its good enough it is, right?)

• Don’t stop at a suggested design!

  • Actual, rather than the expected or anticipated, consequences of the design which are of importance!
    – Verification
    – Validity (content and empirical)

Loops

Future tasks
(predicting the future is easy except for that future part)

• “The characteristics of man as a cognitive system, primarily his adaptability, should not be used as buffer for bad designs, but rather as a beacon for good designs.”

• Talk about Wine in new bottles next time
Question and Discussion Time!

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