From PFA to HJJ: known unknowns

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Trace the *evolving* HJJ ideas

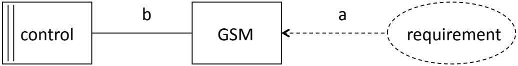
Hayes/Jackson/Jones

Starting point

- shared view that software development not perfect!
- ... for "closed systems", theory is available
- recognition that "open systems" present issues not resolved by:
  - pre/post conditions
  - data reification
  - (sequential) operation decomposition
- Problem Frame Approach [Jac03, Jac00]
- Hayes/Mahony notation for continuous time reasoning
- rely/guarantee "thinking"

An unlikely union?

Intuitive PFA diagrams



a: {pos: Height}

b: control ! {dir: up | down, motor: on | off}
GSM ! {top: Bool, bot: Bool}

Hayes/Mahony notation

often face reality where values vary continuously — cf. Duration Calculus

$$
\begin{array}{l}
SluiceGateRequirement \triangleq \\
\quad \lambda T : Interval(Time) \cdot \\
\qquad \forall I : Interval(T) \cdot \\
\qquad\qquad \# I \geq 6 hours \;\; \Rightarrow \\
\qquad\qquad\qquad \int_I (pos = \textbf{open}) \in \frac{1}{6} * \# I \pm (\textbf{max\_open} + \# I * \textbf{Error}) \wedge \\
\qquad\qquad\qquad \int_I (pos = \textbf{closed}) \in \frac{5}{6} * \# I \pm (\textbf{max\_closed} + \# I * \textbf{Error})
\end{array}
$$

Rely/guarantee proof rules

. . . compositional

$$\boxed{\textit{Par-I}}\ \frac{\begin{array}{l}\{P, R \lor Gr\}\ sl\ \{Gl, Ql\} \\ \{P, R \lor Gl\}\ sr\ \{Gr, Qr\} \\ Gl \lor Gr\ \Rightarrow\ G \\ \overleftarrow{P} \land Ql \land Qr \land (R \lor Gl \lor Gr)^{*}\ \Rightarrow\ Q\end{array}}{\{P, R\}\ sl\ ||\ sr\ \{G, Q\}}$$

"R/G Approach" — not a specific set of rules

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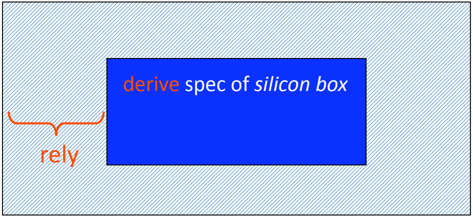
The good news

HJJ outline

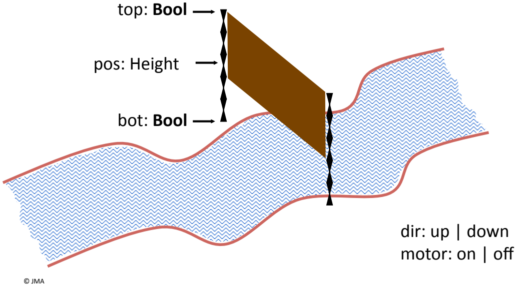
- examples of “deducing specifications” from the wider system
- ground understanding in external world (as in PFA)
- make (agree and *record*) assumptions about physical components
- . . . but *do not model them in detail*
- derive the specification of “silicon box”
- . . . and certainly don’t just jump into specifying the silicon box
- we’ll come back to: when assumptions not satisfied

Simple message

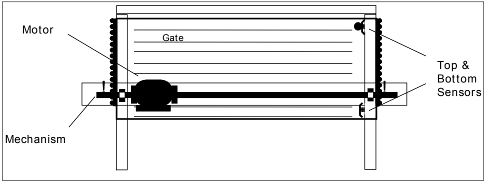
specify *overall* system



Intuition of Sluice Gate System



No water!



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Sluice Gate System

- relatively simple system
- no difficulty (given above notations) to specify normal behaviour
- SGS presents two interesting fault-tolerance issues
  - slow (stuck?) gate
  - top/bottom sensors “open circuit” (or flickering)
- at one level, just weaker R/G specs
- some help from “Deontic implications”

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Known unknowns

- there is no fixed way of saying how wide a "system" is
- Manuel's objection: where is the "method"
- fault tolerance (FT): in one sense, just weaker rely conditions
- view behaviour in "layers"
- ... not just a big conjunction of implications
- some traction with "faults as interference"
- ... dates back to ISAT study
- but this leaves the issue of describing "phase changes"
- technical questions about (timing) handover
- "discussion" about separating FT behaviour from normal
- probabilities (R/G-A?)

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Method

- erudite discussions (on Descartes et al.) twixt Michael and Manuel
- see some steps:
  1. choose a system perimeter
  2. specify/agree ideal (physical world) requirements
  3. define/agree assumptions
  4. repeat steps 2–3 with weaker assumptions
  5. handle “composition issue”
- Manuel talks of “LFTS”
- I recall Michael (about JSP) asking that “methods be normative”!
- Michael’s “operational principles” (radical design)
  - . . . more later?

TimeBands

Alan Burns and Ian Hayes

- powerful idea
- view different granularities of time
- . . . add “precision”, etc.
- certainly promising
- like the way exceptions seen as crossing TimeBands
- but (for my taste) getting overly complicated
- “events” vs. “activities”
- “timeless TimeBands” (fuzzy everything)
- now suspect that we only need “precision”

Teleo-Reactive notation

Nilsson (via Keith Clark) to Ian Hayes

- originally for programming robots
- state changes cause guards to be re-evaluated
- (these are not "action systems")
- neat way of showing the interrupts for exceptions
- in one sense, shifts the question to semantics of TR
- . . . but puts it in one place

Thank yous

- thank you (Michael) for (JSP, ...) PFA
- . . . and the challenges
- . . . and the discussions
- *Dubium Sapientiae initium* Descartes

References

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