

# Software Reliability and Safety

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## **SSE.4: Formal/New Methods for Safety**

- Formal Methods: Axiomatic etc.  
— SQP Chapter 15 and related slides
- Applications in SSE: PSC, etc.
- New Development: STAMP & STPA
- CPS/IoT/HCI/etc. Quality Concerns

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## FM in SSE

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- Leveson approach
  - ▷ Focused verification
  - ▷ Driven by hazard analysis
  - ▷ Distributed over development phases
  - ▷ Which FM? ad hoc
  
- Specific FM: SQE Ch.15 (slides!)
  - but with a safety focus/perspective
  
- Other applications
  - ▷ Need automation ⇒ model checking.
  - ▷ Less formality
    - ⇒ Parnas/tabular method & formal insp.
  - ▷ With statistical testing ⇒ Cleanroom
  - ▷ Yih/Tian: PSC (next module)

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## FM: 7 Myths and 10 Commandments

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- Seven myths (Hall, 1990)
  - ▷ FM guarantee that software is perfect
  - ▷ They work by proving correctness
  - ▷ Only highly critical system benefits
  - ▷ FM involve complex mathematics
  - ▷ FM increase cost of development
  - ▷ They are incomprehensible to client
  - ▷ Nobody uses them for real projects
  
- Refutations and discussions
  
- However, some validity/quantified

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## FM: 7 Myths and 10 Commandments

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- 10 Commandments ... 10 Years Later  
(Bowen and Hinchey, 2006)
  - I. Thou shalt choose  
an appropriate notation
  - II. Thou shalt formalize  
but not overformalize
  - III. Thou shalt estimate costs
  - IV. Thou shalt have a FM guru on call
  - V. Thou shalt not  
abandon thy trad. dev. methods
  - VI. Thou shalt document sufficiently
  - VII. Thou shalt not  
compromise thy quality standards
  - VIII. Thou shalt not be dogmatic
  - IX. Thou shalt test, test, and test again
  - X. Thou shalt reuse
  
- Still valid after 10 years!

## PSC and Safety

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- Why?
  - ▷ Accident reports/empirical data:
    - mostly interface/interaction problems
  - ▷ Need systematic analysis
  - ▷ Existing approaches: combined idea?
  
- How?
  - ▷ Model: TFM (two-frame model)
  - ▷ Analysis of interfaces/interactions
  - ▷ Root cause of I/I problems:
    - physical vs. logical frame consistency
  - ▷ FM and particularly model checking ideas
  
- Slides SQE 16.5

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## STAMP and STPA

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- Leveson's recent work:
  - ▷ After "Safeware"
  - ▷ Roots in systems and control theory
  - ▷ STAMP: Systems-Theoretic Accident Model and Processes
  - ▷ STPA: STAmP Analysis
- Several papers and slides on Canvas.
- New book by Nancy G. Leveson:  
"Engineering A Safer World: Systems Thinking Applied to Safety,"  
MIT Press, 2011.  
ISBN: 9780262016629

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## Other Recent Work

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- Survey of new accident:
  - similar findings
- FM-related work:
  - larger systems and applications
- Safety as part of dependability:
  - dependable and secure computing
  - safety trade-off
  - diversity and dependability (and safety)
  - integrating safetyreliability/usability
- New application domains:
  - net-centric: DoD/DARPA/etc.
  - NASA work
  - IoT/Big-Data and safety
  - many others
- Many active new frontiers for SSE research