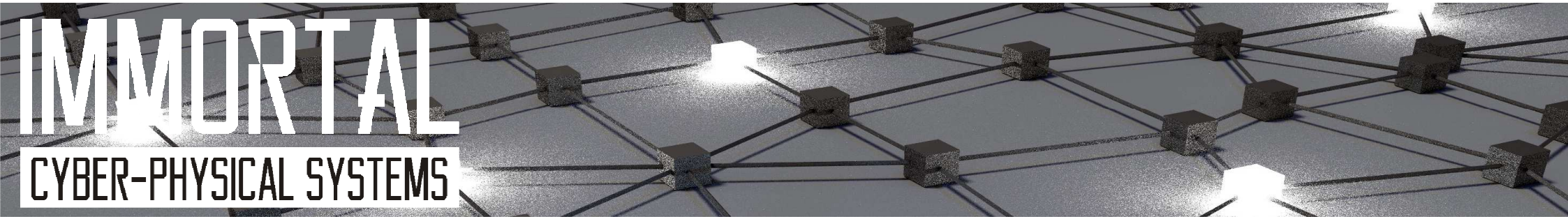


Immortalizing Many-Core Based Cyber-Physical Systems

Heinz Riener

DLR e.V., Germany

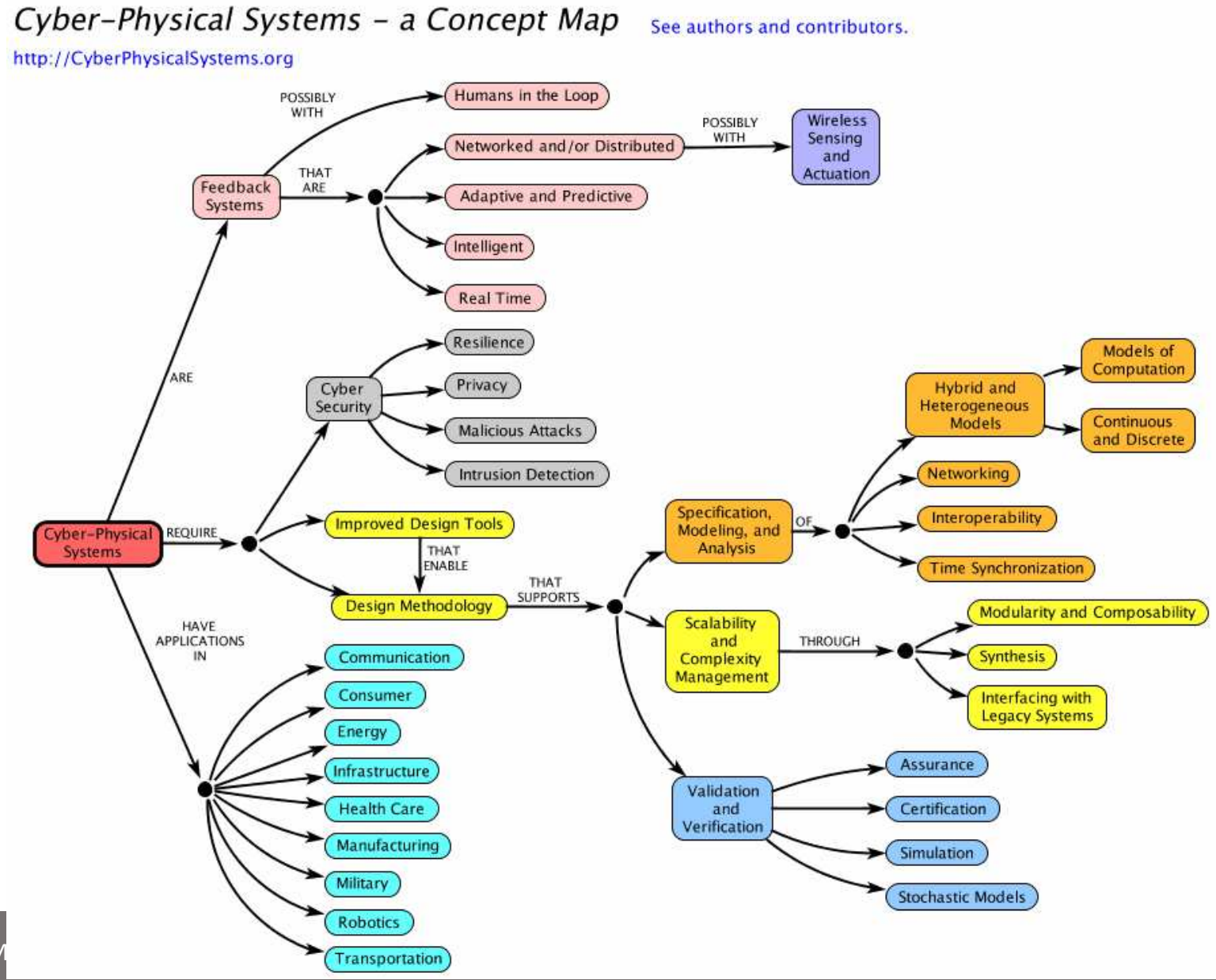
Immortalizing Many-Core Based CPSs

- Facts and figures
- Concept and objectives
- Cross-layer fault management
- In-depth: SMT-Based Parameter Synthesis for CPS

About the Funding Scheme

- **Research and Innovation Actions (RIA):** Funding for research projects tackling clearly defined challenges, which can lead to the development of new knowledge or a new technology.
- H2020 call1 2014 - topic ICT1 "Smart Cyber-Physical Systems“:
  - Modelling and integration frameworks
  - Smart, cooperative and open CPS
- From 140 submissions 8 RIAs selected (acceptance rate 5.7%!)

Dependability and automated debug largely overlooked by previous CPS frameworks!



IMMORTAL: Facts and Figures

- IMMORTAL - Integrated Modelling, Fault Management, Verification and Reliable Design Environment for Cyber-Physical Systems
- 3 years: 2015-2018, 4MEUR
- Partners: Tallinn University of Technology (coordinator), IBM, German Aerospace Center DLR, Recore Systems, Testonica Lab OÜ, Graz University of Technology, University of Twente

Synergy of competences

- **DLR**: Space applications, CPS modeling, automated debug
- **TU Graz**: Modeling, automated debug
- **Recore**: Dependable many-core architecture, run-time
- **Testonica**: Instrument network for fault reporting, fault management
- **Tallinn**: Qualification/minimization of fault monitors, fault management
- **IBM**: Fault monitors, automated reliability sign-off
- **Twente**: Fault models for analog/ mixed-signal

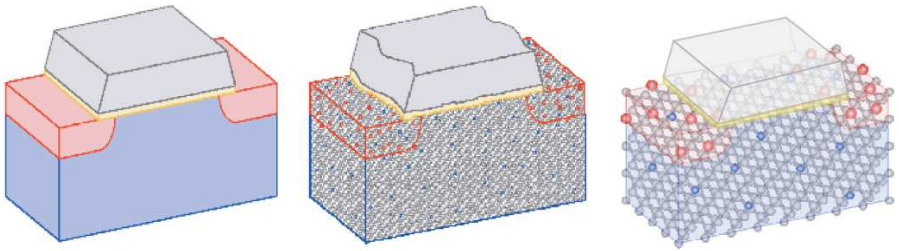
IMMORTAL Objectives

- CAD framework for designing reliable CPS
- Cross-layer holistic fault modeling of CPS
- Fault management enabling rapid fault recovery and life-time extension for many-core based CPS
- Automated localization and correction of bugs in CPS models

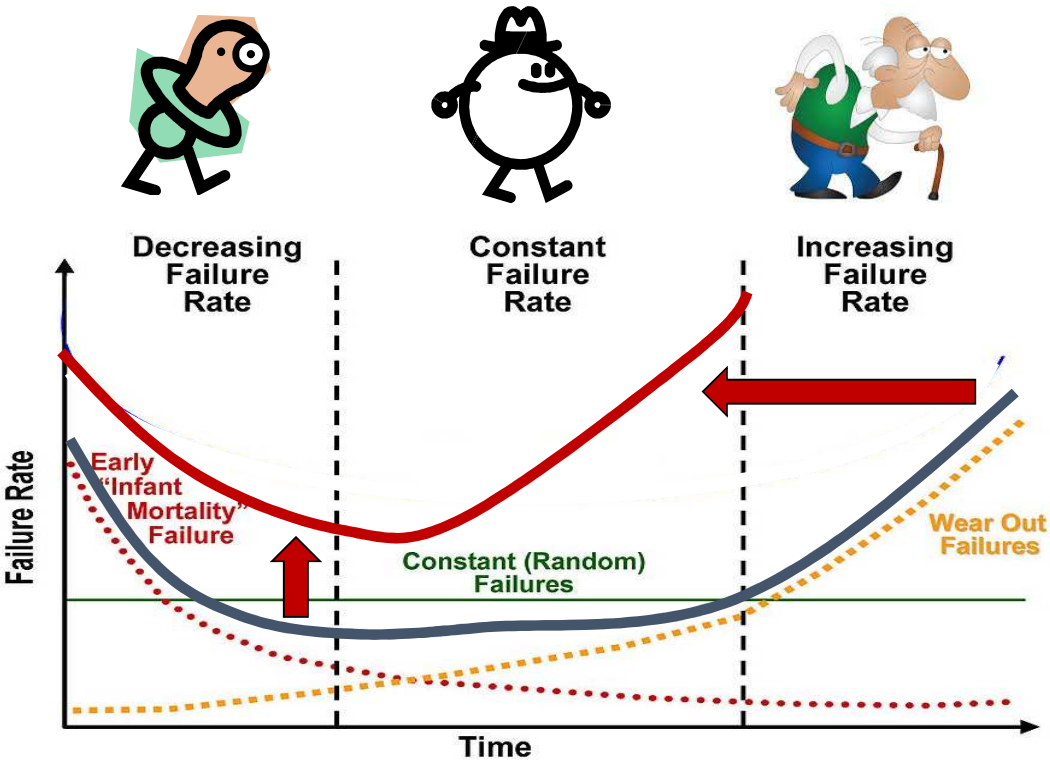
Why a holistic fault model?

Probability of failures (Bath tub)

- Process variations
- Soft errors, EMC
- Aging phenomenon
  - NBTI (PBTI), Hot Carrier Injection, Electromigration

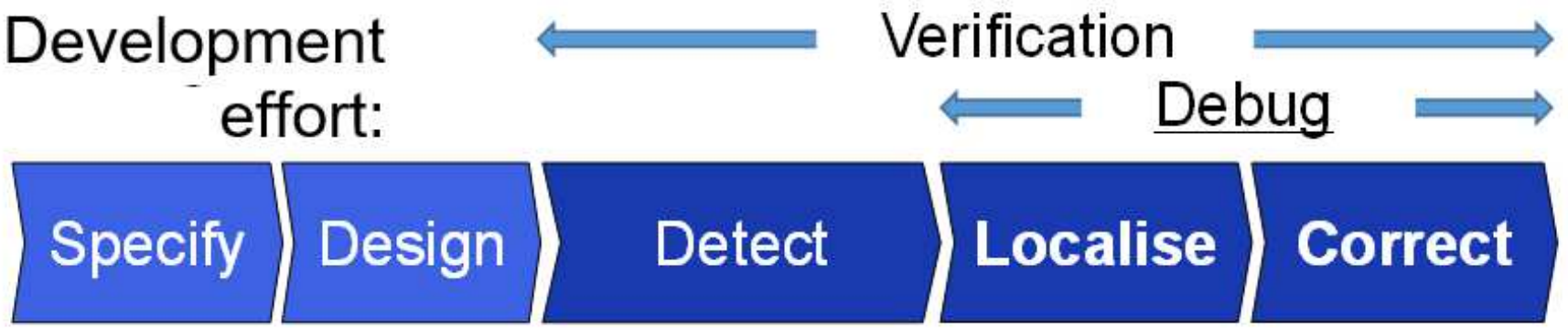


Micrometer technology | 22 nm | Sub-10 nm

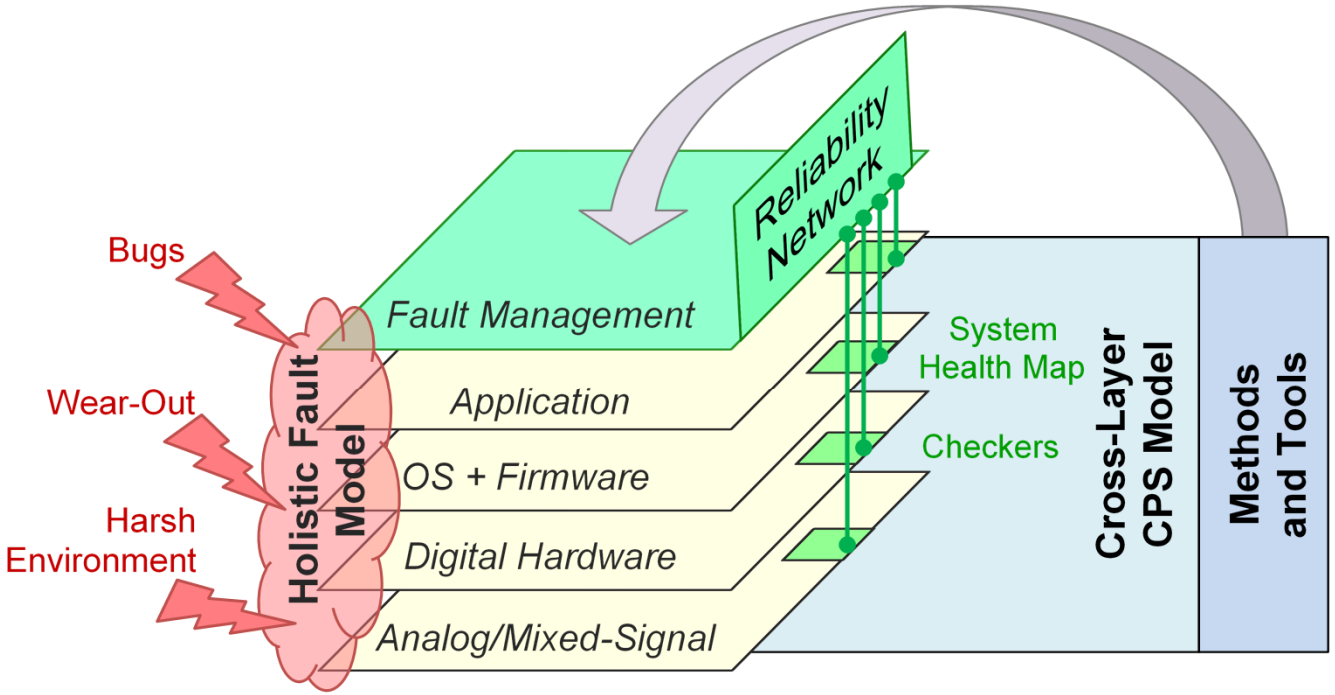


Automated Debug (Localise + Correct)

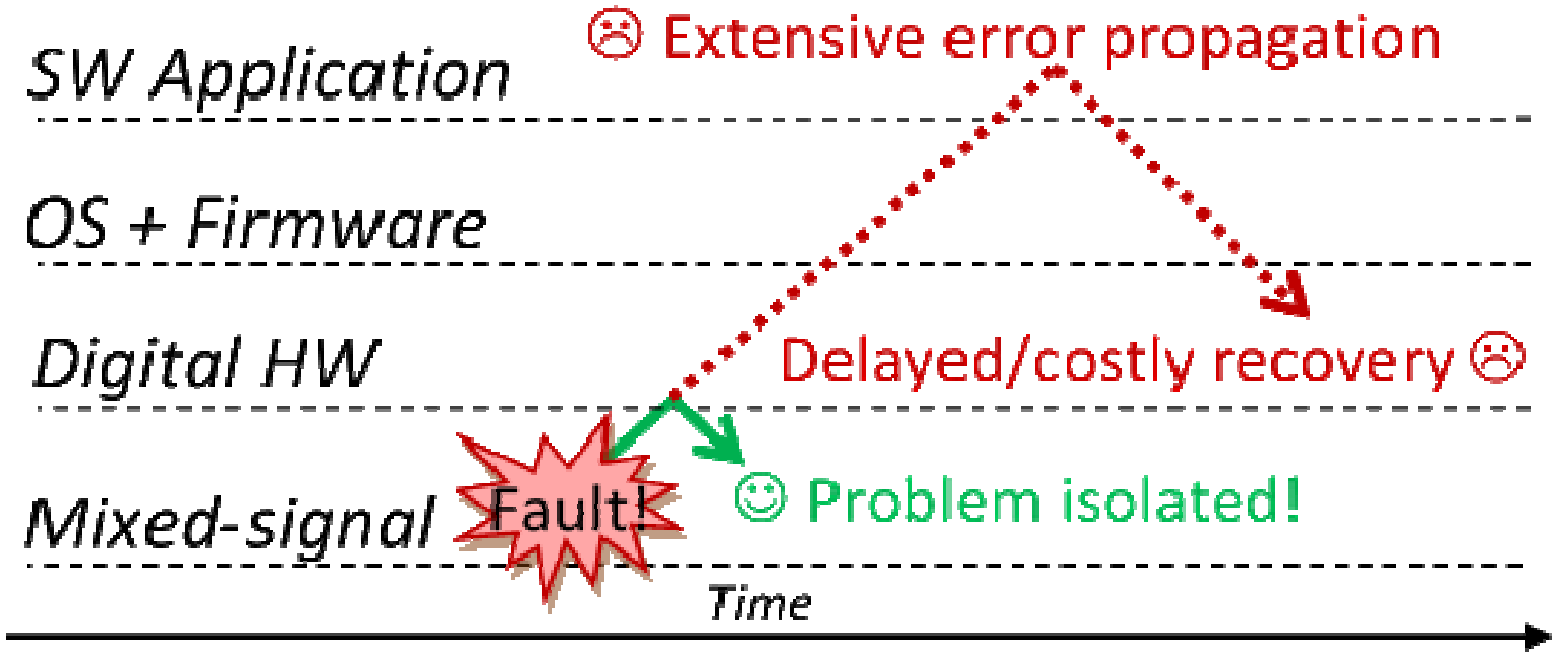
- A major part of the development effort spent on debug
- Automated debug methods for CPS missing



Cross-Layer Fault Management



Fault Detection, Isolation and Recovery



In-depth: SMT-Based Parameter Synthesis for Cyber-Physical Systems

- Sketch a CPS and a specification with open parameters
- Synthesize parameters such that the CPS fulfills the specification
- Example: multi-mode controller synthesis
- Problem: Mixed dynamics, infinite state space
- Our approach: CEGAR-directed search with heuristics to improve performance

(ARCH'16)

Thank you!