

Automated Fault Diagnosis

► Problems

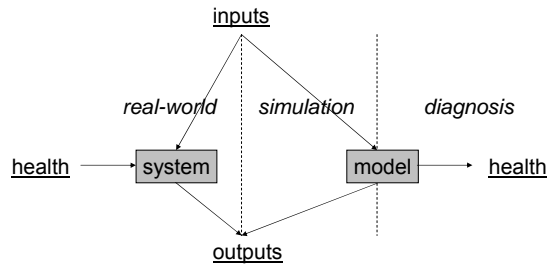


Fault diagnosis of complex systems is difficult and computationally hard. Examples of these complex systems are:

- wafer scanners (ASML)
- copiers (OCE)
- advanced medical equipment (Philips)
- consumer electronics (NXP)

System dependability degrades due to:

- loss of functionality
- long diagnosis time, up to 60 % of down-time
- catastrophic failures (no recovery)



► Solution 1: Model-based

Model-based diagnosis:

- leads to a dramatic decrease in diagnosis time because of automated inference of the system health state from a model and observations. This speed-up requires an investment in modeling effort.

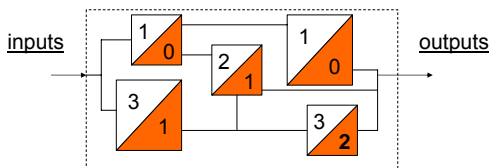
- is a consistent and accurate way to perform diagnosis and to actively disseminate diagnostic knowledge.
- makes use of models that are design-like (e.g. compositional) and therefore easy to adapt to design changes.

An additional benefit is that diagnosis models can also be used to determine sensor placement, system tests and test sequences.

► Solution 2: Spectrum-based

In many cases, e.g., software, system models are NOT available. In these cases we apply Spectrum-Based Localization (SFL), as follows:

1. Measure the activity of components during run-time.
2. Compare the activity measured in good runs with bad ones. (We assume a system oracle)
3. The parts whose activity resembles the occurrence of errors most are the most likely locations of the root causes.



► Tangible Results

Spectrum-based Fault Localization (Trader project):

- tooling (compiler) is in place
- industry (NXP) is very much interested in “technology transfer”

Model-based Diagnosis (Tangram and Finesse projects):

- modeling language and tooling is stable (available from <http://fdir.org/lydia>)
- technology transfer complete, initial results positive (ASML)
- strong performance improvement of diagnosis algorithms
- entropy as diagnostic quality quantifier

► People Involved

Arjan J.C. van Gemund, *full professor*
 Peter Zoetewij, *post-doc*
 Rui Abreu, *PhD student*
 Alex Feldman, *PhD student*

- ► Jurryt Pietersma, *PhD student*
 (... looking for a new job ...)

► In the future, both methods may be combined into a hybrid approach, combining the best of both.