

# PANEL ON FAULT REPRESENTATIVENESS

**GOAL:** to discuss fault injection representativeness in the context of dependability benchmarking.

## SOME QUESTIONS:

- If dependability benchmark is a test (or set of tests) to quantify computer dependability, what is different from traditional fault injection experiments?
- Which classes of faults are relevant?
- How to create a representative mix of classes of faults (let us call it faultload)?
- How to include external features (environment, operation conditions, etc) in the faultloads?
- What is the meaning of 'representative' in this context?
- Is fault representativeness to be discussed in a statistical basis or is the representativeness of a particular fault also important?



## Faults themselves?

- Stuck-at faults for hardware?
- Code mutations for software?

**→ Injected faults are not representative of real faults**

## Fault injection or error injection?

- Are injected faults similar to errors produced by real faults?  
e.g. in SWIFI for hardware faults

## Effects of faults, i.e. errors?

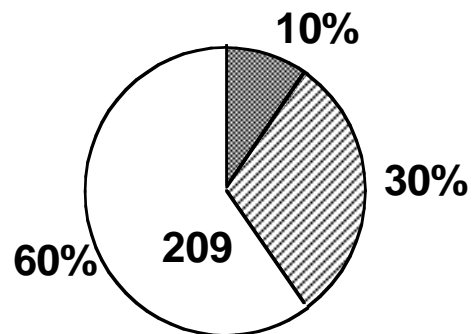
- Relationship between injected faults and real faults is via the produced errors only, in their ability to trigger error-detection and system recovery mechanisms**
- Do simple (injected) faults produce errors similar to real faults?
- External faults **⇒ « robustness testing »**

# Representativeness of software mutations

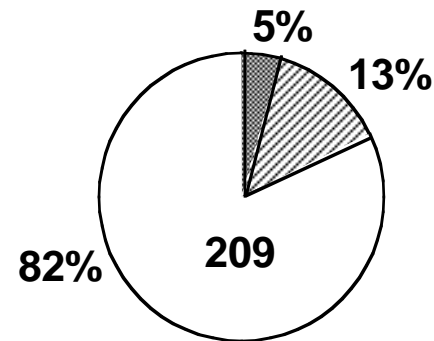
Analysis of the complete mutation data base versus the real fault data base



Analysis of the distinct error sets



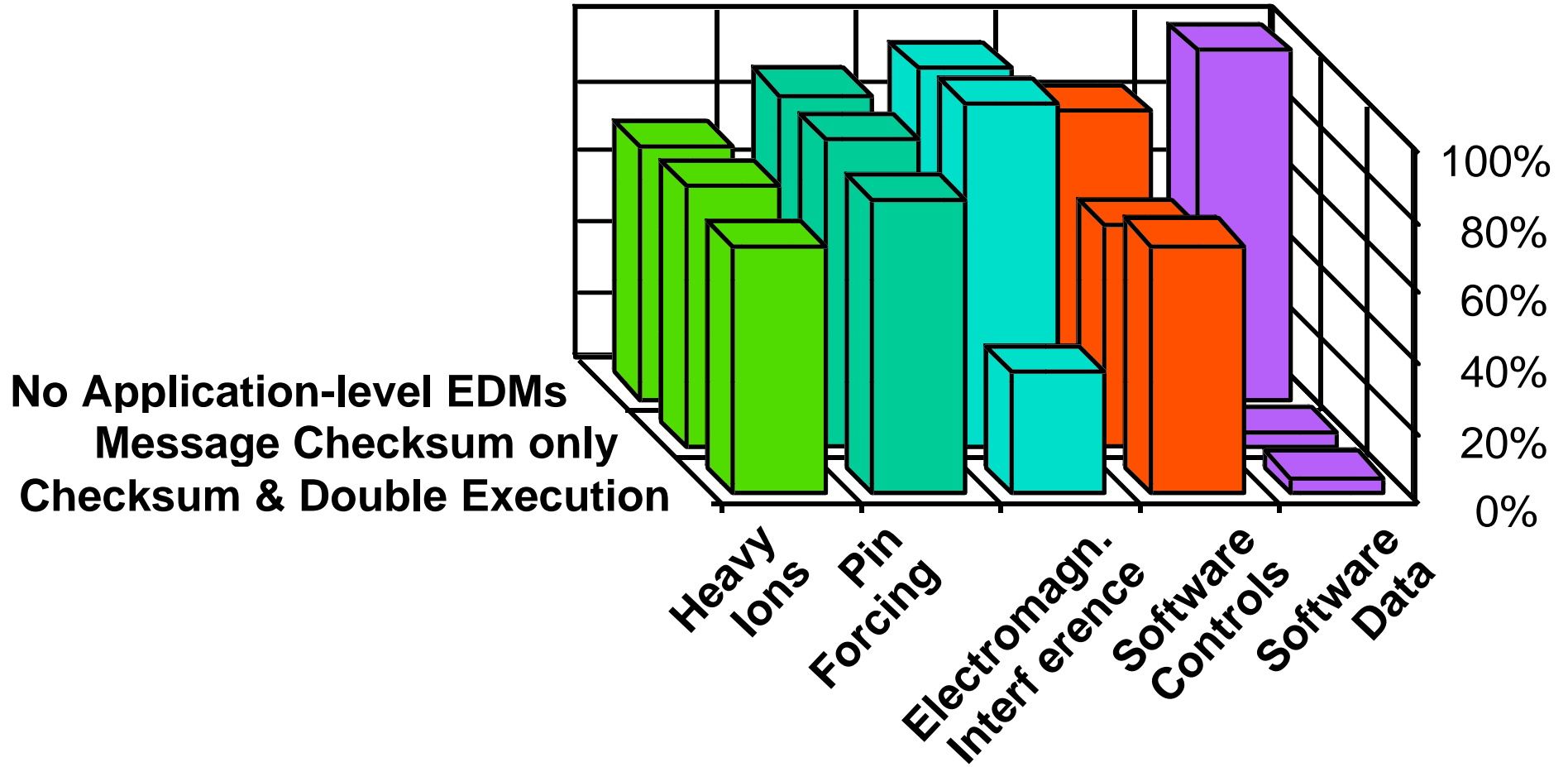
**Mutation-DB**  
(349 distinct errors)



**Real fault-DB**  
(255 distinct errors)

\* development, not operational, faults

# Fault injection in MARS



Detection by the hardware EDMs

\* no error analysis

## SOME QUESTIONS:

- If dependability benchmark is a test (or set of tests) to quantify computer dependability, what is different from traditional fault injection experiments?

☞ **Coverage is not the focus point** ⇨ **dependability measures**

- Which classes of faults are relevant?

☞ **All of them: physical int. & ext., design, human interaction**

- How to create a representative mix of classes of faults (let us call it faultload)?
- How to include external features (environment, operation conditions, etc) in the faultloads?
- What is the meaning of 'representative' in this context?

☞ **Think in terms of errors**

- Is fault representativeness to be discussed in a statistical basis or is the representativeness of a particular fault also important?

☞ **Definitely statistical, in terms of errors**