Towards an Artificial DNA for the Use in Dynamic Environments

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ISORC 2019, Valencia

May 9, 2019
1. Motivation

Current ICT systems:
• Increasingly complex
• Distributed
• Interconnected
• Dynamic environments

➔ Thus,
• Development and maintenance are hard
• Failures at run-time

Idee of Organic Computing:
• System adapts autonomously and dynamically to environment

*(Tomforde et al., „Organic Computing in the Spotlight“, 2017)*
2. Artificial Hormone System

- Assignment of tasks to processors
- Hormone-based control loops
  - Self-configuration
  - Self-improvement
  - Self-healing
- Create virtual organs
3. Artificial DNA

Idea:
- Most embedded systems consist of standard components ➔ Describe components and interconnection as a text file ➔ Artificial DNA
- No programming, only parametrization ➔ Automatically determine tasks and hormone strength

```
1 = 70 (1:2.2) 100 25  // constant setpoint value, period 25 msec
2 = 1 (1:3.1) -  // ALU, control deviation (minus)
3 = 10 (1:4.1) 4 5 6 25 // PID (4, 5, 6), period 25 msec
4 = 600 1  // actor, resource id = 1
5 = 500 (1:2.1) 2 25 // sensor, resource id = 2, period 25 msec
```
4. Dependability

In general:

\[ P_{ADNA} \leq P_{Red}. \]

⇒ Interesting approach for automotive applications
5. Artificial DNA for dynamic environments

- Self-building system at run-time
- Easy to configure at run-time
- Scalable
- ADNAs of different systems may merge and separate
Example

Red car:
- ABS 1
- ESP 1
- Motor control 1
- Entertainment 1
- …

Blue car (less computing power):
- ABS 2
- ESP 2
- Motor control 2
- Entertainment 2
- …
Scenarios:
1. Stress test $\rightarrow$ Different car is in range each 1.5 seconds for 1.5 seconds
2. Replacement for failing processors $\rightarrow$ Different car is in range each 6 seconds for 4.5 seconds
Evaluation scenario 1 (stress test)

- ADNA of red car complete
Evaluation scenario 1 (stress test)

- Reaction time until ADNA is complete
Evaluation scenario 1 (stress test)

- Speed and distance
Evaluation scenario 2 (Replacement for failing processors)

- ADNA of red car complete
Evaluation scenario 2 (Replacement for failing processors)

- Reaction time until ADNA is complete
Evaluation scenario 2 (Replacement for failing processors)

- Speed and distance
Conclusion

• First experiments with extended ADNA for dynamic systems
  • Stress test
  • Compensate failing processors

Future work:
• ADNA assignment priorities
• Conditional ADNA

Then:
• Paywall for automotive applications
Thank you

Questions?