AS-TRM AND FUNCTIONAL SIZE WITH COSMIC-FFP

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Agenda

- Introduction
- COSMIC-FFP Measurement Method
- AS-TRM
- Related Work
- Analysis of Similarities across Models
- Formalizing COSMIC-FFP in AS-TRM context
Context

- Software Engineering: A discipline for the systematic production and maintenance of large and complex software systems [Fenton & Pfleeger 1998]

- Software Measurement: is the mechanism to provide feedback on software quality [Fenton & Pfleeger 1998]

- Size: Systems built for a large number of interactions and with a large number of components [Fenton & Pfleeger 1998]

- Complexity: Overall Behavior can only be predicted with some degree of uncertainty [Fenton & Pfleeger 1998]
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Functional Size

**Functional Size:**
A size of software derived by quantifying the functional user requirements

[ISO 14143-1 definition]
“So you want to measure Software Functional Size?”
COSMIC-FFP Measurement Method
[COSMIC-FFP Manual 2.2]

Engineered Devices

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COSMIC-FFP Measurement Method
[COSMIC-FFP Manual 2.2]

- COSMIC-FFP focuses on the user view (that is to the ‘user requirements’ from a functional perspective, see ISO 14143-1)

- This view is relevant throughout all the software development phases

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Example: COSMIC-FFP Software Functional User Requirement boundary for Rice Cooker application

[Rice Cooker Case Study]
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AS-TRM

- For modeling reactive autonomic distributed systems

- The AS-TRM architecture builds on the TROM formalism for modeling reactive systems by adding more tiers and including the following specifications:
  - Data modeling
  - Timed Reactive Object Model (TROM)
  - Timed reactive autonomic component (AC);
  - Group of synchronously interacting ACs (ACG);
  - Autonomic system (AS), consisting of asynchronously communicating ACGs.
AS-TRM Formal Model

5-Tiered Design Specification

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AS-TRM Formal Model (Script)

- **AC Tier:** This newly added tier encapsulates the TROM objects into the AS-TRM autonomic components. An AC is responsible for undertaking a complete or partial real-time reactive task as a worker within the system.

- **ACG Tier:** each ACG can accomplish a complete real-time reactive task independently. The self-monitoring behaviour at the ACG tier as well as the asynchronous interaction between ACG and its ACs is implemented by an ACG Manager (AGM).

- **AS Tier:** the self-managing behaviour as well as the asynchronous interaction between the AS and the ACGs is implemented by the Global Manager (GM).  

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Hierarchical view of the AS-TRM
At the peer group level, which is also the AS-TRM Component Group (ACG) level, every AGM interacts and shares knowledge as well as information with its ACs; it receives information (policies) from its superior (Global Manager) and implements them with its own resources. The autonomic behavior at this level is a result of peer knowledge-sharing, getting local agreement, and acting locally on that knowledge.
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Related Work: Formalizing COSMIC-FFP  
[Diab, Frappier & St-Denis 2001]

- Formalization of (COSMIC-FFP) measure for the Real-time Object Oriented Modelling (ROOM) language.

- ROOM is now widely used for constructing real-time systems.

- eliminates measurement variance
- automation of COSMIC-FFP measurement for ROOM specifications
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### Analysis of Similarities across Models

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<thead>
<tr>
<th>COSMIC-FFP concepts</th>
<th>AS-TRM formalism notations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>Reactive Component interface</td>
</tr>
<tr>
<td>Layer</td>
<td>Tier in the formal model</td>
</tr>
<tr>
<td>Functional process</td>
<td>Reactive task or self-management task</td>
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<tr>
<td>Triggering event</td>
<td>Shared input event</td>
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<tr>
<td>Data group</td>
<td>LSL trait</td>
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<tr>
<td>Data Movement</td>
<td>Internal &amp; External event (input &amp; output)</td>
</tr>
<tr>
<td>Data Attribute</td>
<td>Operation in the LSL trait</td>
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</tbody>
</table>
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Results of Proposed Comparison

- The COSMIC-FFP method would complement the complexity management in AS-TRM allowing for early complexity assessment from the formal specification.

- **Proof of concept** through Steam Boiler Case Study.
Steam Boiler Case Study

Diagram showing a water tank with levels M1, N1, N2, M2. The tank has a water level measuring device, a pump, and a valve. A controller is connected to the tank and pump. The diagram illustrates the flow from the pump to the controller and back to the tank.
Steam Boiler Controller

Reactive Component interface

Sensor measurer

Steam Boiler Controller

Pump

Valve
## Total Software Functional Size for Steam Boiler using AS-TRM terms

<table>
<thead>
<tr>
<th>Tier i</th>
<th>Reactive task</th>
<th>Sequence of events</th>
<th>Type of event</th>
<th>Corresponding functional size</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Maintain Level</td>
<td>1. Obtain the water level measurement (value = below normal, normal or above normal)</td>
<td>Shared input event</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. (Logic) Check if any action is needed; if not, terminate the cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Send message to Pump (value = open or close)</td>
<td>External output event</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Send message to Valve (value = open or close)</td>
<td>External output event</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Functional size of Steam Boiler Controller software** 3 Cfsu
Thank You!

Questions?

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References


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References


