A Flexible Context Stabilization Approach for Self-Adaptive Application

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Outline

1. Context & Problem Statement

2. A Flexible Context Stabilization Approach

3. Evaluation

4. Conclusion & Perspective
Context

• Is self-adaptive system the new success story?
  • Increasing demands
    – Economy and financial system
    – Business and military strategic planning
    – Ubiquitous computing and etc..
  • Several research fields mobilize
    – Control theory
    – Artificial intelligence
    – Software engineering and etc.
Context

• Reasons of “rushing” to self-adaptive system
  • *Complexity of software systems*
  • *Cost of application maintenance*
  • *Market perspectives*
  • *Technological / Scientific challenges*
Problem Statement

- Autonomic systems [kephart’03]
Problem Statement

• Self-adaptive system
  • *Dynamic context*

*Continuously adapt to changes*

*System instability*
Problem Statement

• Self-adaptive system
  • Dynamic context

Continuously adapt to changes

System stable

Stabilization mechanisms
Problem Statement

• Motivations for Stabilization Mechanisms (SM)
  • *SM are nested in decision making*
    – *Increase adaptation cost*
  • *SM are difficult to customize (efficiency)*
  • *SM not flexible* (reuse across platform)
  • *SM have a limited scalability*
Problem Statement

• How to meet the challenge?

1. *Stabilization of self-adaptive system is a cross-cutting problem*

2. *Provide a flexible and transparent methodology to integrate stabilization mechanisms in self-adaptive system*
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Flexible Stabilization Approach: Definition

• Stabilization Techniques (ST):

  algorithms and mechanisms aiming to regulate the responsiveness of context-aware systems, allowing their (re-)configuration when significant changes occur in their surrounding.
Flexible Stabilization Approach: Classification
Flexible Stabilization Approach

• Stabilization as a cross-cutting concern
Flexible Stabilization Approach
Flexible Stabilization Approach

How do we integrate stabilization algorithms?
Flexible Stabilization Approach: Classification

• Stabilization techniques lessons from the SotA
  • A unique and optimal ST does not exist
    – Each group of stabilization techniques has its strength and weakness
  • A ST is efficient and optimal only for a set of case study

• Combination of ST provides better results
Flexible Stabilization Approach: Strategy

• Composition Strategies
  – *Horizontal composition*
    – Concurrent execution of stabilization algorithms
    – Improve accuracy of the stabilization
  – *Vertical composition*
    – Sequential execution of several stabilization techniques
    – Improve efficiency of stabilization
Flexible Stabilization Approach: Strategy
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Flexible Stabilization Approach: Evaluation

• Experiments Description
  • Platforms
    – COSMOS framework - Context management
    – SIAFU – Context generator

• Measurements
  – Temperature variations around set range
  – Delta Operator (DO) and Kalman Filter (KF) Stabilization techniques
Flexible Stabilization Approach: Evaluation
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Conclusion & Perspective

• Propose a flexible approach to handle stabilization for self-adaptive systems
  • Composition strategies
    – Horizontal: improve accuracy
    – Vertical: improve efficiency
  • Integration of SotA ST

• Perspective
  • Deploy our approach in a real very-large-scale application (SALTY)
QUESTION ?

Thank you !!!