

ACon: A Learning-Based Approach to deal with Uncertainty in Contextual Requirements at Runtime

Alessia Knauss¹, Daniela Damian¹, Xavier Franch², Angela Rook¹, Hausi A. Müller¹, Alex Thomo¹

¹University of Victoria, Victoria, BC, Canada

²Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

franch@essi.upc.edu (contact author)

Keywords: Requirements engineering; Self-adaptive systems; Contextual requirements; Operationalization; Machine learning.

In: Information and Software Technology, 70 (2016): 85-99. (DOI: <https://doi.org/10.1016/j.infsof.2015.10.001>)

Context: Runtime uncertainty such as unpredictable operational environment and failure of sensors that gather environmental data is a well-known challenge for adaptive systems.

Objective: To execute requirements that depend on context correctly, the system needs up-to-date knowledge about the context relevant to such requirements. Techniques to cope with uncertainty in contextual requirements are currently underrepresented. In this paper we present ACon (Adaptation of Contextual requirements), a data-mining approach to deal with runtime uncertainty affecting contextual requirements.

Method: ACon uses feedback loops to maintain up-to-date knowledge about contextual requirements based on current context information in which contextual requirements are valid at runtime. Upon detecting that contextual requirements are affected by runtime uncertainty, ACon analyses and mines contextual data, to (re-)operationalize context and therefore update the information about contextual requirements.

Results: We evaluate ACon in an empirical study of an activity scheduling system used by a crew of 4 rowers in a wild and unpredictable environment using a complex monitoring infrastructure. Our study focused on evaluating the data mining part of ACon and analysed the sensor data collected onboard from 46 sensors and 90,748 measurements per sensor.

Conclusion: ACon is an important step in dealing with uncertainty affecting contextual requirements at runtime while considering end-user interaction. ACon supports systems in analysing the environment to adapt contextual requirements and complements existing requirements monitoring approaches by keeping the requirements monitoring specification up-to-date. Consequently, it avoids manual analysis that is usually costly in today's complex system environments.