8th REA Symposium Embracing Resilience: Scaling up and Speeding up
Kalmar, Sweden, June 24-27, 2019

A LATENCY-BASED METRIC FOR LAYERED CONTROL MODELS

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Abstract
Contextual control models suggest that layers of functionality provide functionality on different abstraction levels. Lower levels exhibits faster feed back loops compared to higher levels. The ability of a system to maintain control (and hence safe operations) is related to its ability to react faster than the change rate in the relevant operational environment.

This paper suggests that temporal relations based on the duration between events; latency, can provide a rational metric for quantification of relations between functional levels in a contextual control model. Latency may serve as a parameter in defining methods for control in distributed asynchronous systems. It also suggests that the ability of a system described with a layered control model to maintain coherent and purposeful operations can be represented by latency based metrics such as "noise level" and "incubation time". Hence, loss of control could be described, designed and predicted in quantitative terms.

Use of the latency based metric is exemplified with application to control of unmanned surface vehicles (boats; quantifying and replacing qualitative "levels of autonomy"-models) and safety-margin calculations in shipping, based on the relations between temporal margins given by assessment and prediction of relative motions and maneuverability.

ISBN: 978-91-88898-41-8