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Aggregate Computing

Short Intro

Aggregate programming provides an alternate approach to the standard device-centered development methodology, aiming to dramatically simplify the design, creation, and maintenance of complex and large scale software systems, specifically in the context of IoT, cyber-physical systems, pervasive computing, robotic swarms, and large-scale situated systems in general. Under this approach, the reference computing machine is no longer the single device, but is instead the aggregate collection of devices that cooperatively carry out a computational process: the details of behaviour, position and number of devices are largely abstracted away, to be replaced with a space-filling computational environment. Hence, with aggregate programming the availability of large, heterogeneous sets of devices becomes less of a concern and more an opportunity to increase the quality (e.g., soundness, stability, efficacy).

Stack of models and technologies

- Computational fields: maps from devices to values; in our approach "everything is a field"
- Computational Field Calculus: a tiny language, amenable to formal treatment, describing computations over fields
- Protelis language: a Java-oriented, Java-enabled programming language to construct aggregate computations based on the computational field calculus
- Alchemist: a fast simulator, with ability (among the others) of running Protelis, other than importing maps, GPS traces, images and so on

News

- Paper accepted at SASO 2015! AggregateComputingSASO2015
- I'll be giving a keynote speech at the "Collective Adaptation in very large scale UBICOMP: The Superorganism of Massive Collective Wearables" UBICOMP workshop, sponsored by FOCAS (http://focas.eu/towards-superorganism-wearables/)

Bibliography (recommendations for readings/citations)

- PatternNaco2012: A catalogue of patterns of self-organisation
- AlchemistJos2013: Presentation of the architecture of Alchemist simulator
- SurveySpatialIGI: Survey on previous aggregate computing-related attempts
- SpacetimeRsta373: Survey of the space-time computing approach to aggregate computing
- FieldCalculusFOCLASA2013: Presentation of the computational field calculus (journal version to come)
- SpatialCoordination2014: A fragment of field calculus proved self-stabilising (journal version to come)
- FieldsScw2014: A universality result for the computational field calculus
- ComputationalfieldsForte2015: Adding higher-order features to computational field calculus, key to support openness
- FOCAS2014: Proposing a set of building blocks on top of field calculus, to scale with complexity
- SpacetimeRsta373: A survey in the potentials and challenges of aggregate computing (more generally, space-time computing)