Configuration of Wireless Sensor Networks

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Abstract
Wireless ad hoc networks of sensor nodes are envisioned to be deployed in the physical environment to monitor a wide variety of real-world phenomena. My PhD project is concerned with the configuration of wireless sensor networks and with generic high-level programming abstractions for specifying configuration problems.

Keywords
Wireless sensor networks, self-configuration, programming abstractions, facility location

Problem Statement and Research Question
Configuration of wireless sensor networks is an essential element for the efficient operation of these networks, as it enables, for example, more efficient routing and data gathering approaches.

Further, *automatic* configuration is required as manual configuration of individual nodes is not possible due to the envisioned network size. *Distributed* configuration is required as centralized offline configuration is often infeasible due to the prohibitively high effort required to collect in-situ node parameters (such as node position or network neighbours) at the sink.

Last but not least, *generic* high-level abstractions are important as these make life easier for application-domain experts (vulcanologists and the like) which are envisioned users of wireless sensor networks and currently struggle with low-level programming of the available prototype systems.

Preliminary Results

So far, we have studied a generic programming abstraction that allows for rapid prototyping of sensor-network configurations – such as clustering – using concise declarative programs [1]. Specifically, we have looked at the efficiency of a distributed implementation [2] and at the properties of an exact solution of the specified configuration problems through a generic translation of specified configuration problems into integer linear programs (ILPs) [3].

Conclusions and Future Steps

The current distributed approach [2] did not focus on optimality of the obtained configurations, but on ease-of-use (specifically that the desired configuration could be described in only a few lines of code) and on an efficient implementation of the distributed algorithms. In the future, I plan to investigate how similar configuration problems can be supported by a distributed approximation of the *facility location problem*, which has previously been used in operations research to place distribution centres such that they (optimally) serve customers, e.g., in a street network. The envisioned algorithm, being a generalization of the *minimum dominating set problem* commonly approximated in clustering algorithms, can be parameterized more flexibly and be applied to a larger class of configuration problems – compared to existing algorithms (e.g., for clustering or data aggregation) that have been studied in related work so far.

References

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