Invited Talk

Programming Embedded Networked Sensor Systems

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Abstract
This talk describes a state-centric abstraction for application users to interact with sensor networks. Just as in data-centric routing and storage where physical nodes are less important than the data itself, state-centric abstraction introduces "states" as a natural vocabulary to describe spatio-temporal physical phenomena that the sensor networks are typically designed for. Application programmers specify the computation as creation, sharing, and transformation of states, which naturally map to descriptions in signal processing and control applications. We argue that due to the dynamic nature of sensor networks, programs written in state-centric abstractions are more invariant to constant changes in data stream configurations and make the resulting software more portable across multiple sensor network platforms. With help of models of sensor collaboration, sensing, and estimation, the state-centric specifications are mapped into collaborative processing tasks at compile time, and further maintained at run time, leveraging the data-centric caching and routing services. We use a multi-target tracking system as an example to show how state-centric programming models can raise the abstraction level for users to interact with sensor networks and help modularize the design.

Biography of Feng Zhao
Feng Zhao is a Principal Scientist and manages the Embedded Collaborative Computing Area in the Systems and Practices Laboratory at PARC (formerly known as Xerox PARC). He is also Consulting Associate Professor of Computer Science at Stanford. The two main projects in his group, Collaborative Sensing and Smart Matter Diagnostics, investigate how MEMS sensor and networking technology can change the way we build and interact with physical devices and environments. His research interest includes distributed sensor data analysis, diagnostics, qualitative reasoning, and control of dynamical systems.

Dr. Zhao received his PhD in Electrical Engineering and Computer Science from MIT in 1992, where he developed one of the first algorithms for fast N-body computation in three spatial dimensions and phase-space nonlinear control synthesis. From 1992 to 1999, he was Assistant and Associate Professor of Computer and Information Science at Ohio State University. His INSIGHT Group developed the SAL software tool for rapid prototyping of spatio-temporal data analysis applications; the tool is currently used by a number of other research groups.

Dr. Zhao received the ONR Young Investigator Award and the NSF Young Investigator Award, and was an Alfred P. Sloan Research Fellow in Computer Science. He serves on the editorial boards of IEEE Transaction on Signal Processing, IEEE Transaction on Control Systems Technology, AI Magazine, New Generation Computing, and guest co-edited an IEEE Signal Processing Magazine special issue on collaborative signal and information processing (CSIP) in microsensor networks. He co-chaired the 1st and 2nd International Workshop on Information Processing in Sensor Networks (IPSN: www.parc.com/events/ipsn03). He has authored or co-authored over 90 technical papers in the areas of networked embedded systems, artificial intelligence, nonlinear control, and programming tools, and is a co-inventor of three US Patents and five pending patent applications.

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