Demo: Near-optimal Data-Driven Placement of Light Sensors under Communication Constraints

Andreas Krause *CMU*

Carlos Guestrin *CMU*

Anupam Gupta *CMU*

Jon Kleinberg *Cornell*

Our demonstration allows the user to interactively solve a *sensor placement problem*: Where in a building should wireless sensors be deployed to become most certain about the illumination with natural light? Not only should the sensors be *informative*, but they should also be able to *communicate efficiently*. We will demonstrate our *data-driven approach*, which addresses three central aspects of this problem:

1. measuring the *predictive quality* of a set of sensor locations (regardless of whether sensors were ever placed there),
2. predicting the *communication cost* involved with these placements,
3. an algorithm with *provable quality guarantees* that optimizes the **NP**-hard tradeoff.

Specifically, we use data from a pilot deployment to build non-parametric probabilistic models called *Gaussian Processes* (GPs) both for the spatial phenomena of interest and for the spatial variability of link qualities, which allows us to estimate predictive power and communication cost of unsensed locations. Based on these models, our novel, polynomial-time, data-driven algorithm, **pSPIEL**, will select *Sensor Placements at Informative and cost-Effective Locations*. Our algorithm has strong theoretical approximation guarantees. In this demonstration we will show that it also performs well in practice.

In our demonstration setup, a video projector projects light patterns onto a screen representing a building. Wireless sensors are attached to collect data. Users can play back *recorded sensor data*, and even *influence the generation* of the light patterns by specifying the amount of variation in different areas of the building using a graphical user interface. They can also specify communication constraints by placing obstacles such as walls. Upon a short time of data collection, an improved placement will be displayed, naturally corresponding to the variability in the observed light patterns and respecting the communication constraints. The setup is illustrated in Figure 1.

This demonstration accompanies the paper "Near-optimal Sensor Placements: Maximizing Information while Minimizing Communication Cost" by Andreas Krause, Carlos Guestrin, Anupam Gupta and Jon Kleinberg.

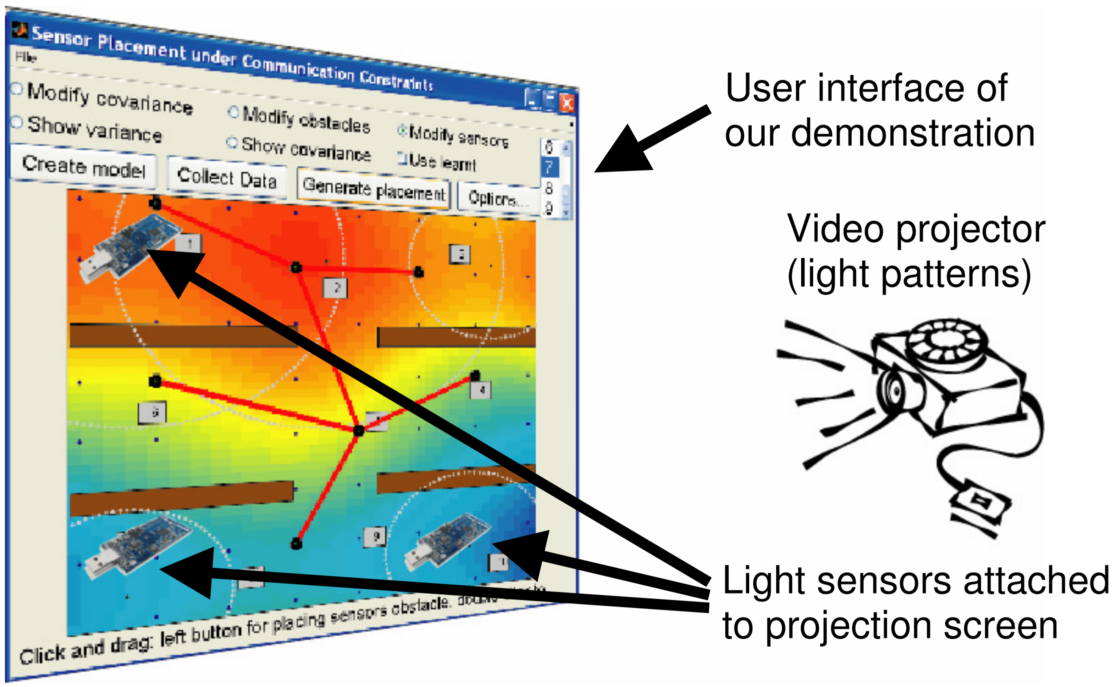

Figure 1: Illustration of our demonstration setup. A video projector will project light patterns to the screen, simulating the phenomenon of interest (colored surface). From the measurements made by the attached sensors, we learn a model and optimize the sensor placement (shown as black dots, connected by the optimal communication links in red). Users can modify the phenomenon, and add walls (brown rectangles) to model communication constraints.