ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Master Thesis proposal

Title (tentative)	:	Autonomous Monitoring Strategies for Estimating Thresholds of Spatial Phenomena
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The objective of this Master Thesis is the estimation of function contours by obtaining a series of measurements, which, as a problem setting, can be used in the context of various real-world phenomena involving one or more spatially varying parameters, such as temperature, concentration of chemicals, magnitude of seismic waves, etc.

In particular, we aim to develop a strategy for collecting measurements based on modeling the underlying phenomenon by a Gaussian Process and focusing on the following three aspects: First, our strategy should be *active* in the sense that the outcomes of past measurements should determine the choice of future ones. Second, we would like to select as *informative* measurements as possible, in order to obtain an accurate estimate of the desired thresholds. Third, our strategy should be *efficient*, not only in terms of the number of required measurements, but also with respect to the route taken to obtain said measurements. For this purpose, we intend to incorporate a path-planning component into the selection process.

The strategy to be developed will be evaluated on synthetic and real-world datasets. An issue that will require investigation is the way in which the performance of a strategy is measured, so as to be able to improve our strategy and compare it to existing ones. In addition to improving the strategy itself, we will also look into the matter of appropriately choosing Gaussian Process kernels and hyperparameters and the effect that these have on the results.

Finally, we plan to deploy an implementation of our strategy as part of a robotic vehicle in Lake Zurich in collaboration with the Autonomous Systems Lab of ETH and measure its performance in this real-world scenario.