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Zurich, 16/10/2020

State-Estimation and Self-Calibration: from Multiple Sensors to Multiple Agents

The talk was about the amount of information coming from sensors' measurements and how does this affect the quality of the outputs. The main claim of the speaker was that more data doesn't always imply better results: "more data is confusing, until is just the right amount". Every sensor produces more information, but it also adds the unknowns of its extrinsic and intrinsic characteristics. The perception-action-cycle consist in sensing data, selecting raw information, processing by extracting only the relevant information and producing outputs. The goal of modern research is to eliminate the selection, to use the totality of the data, and to filter according to the relative importance. In standard approaches the corners and edges carry most of the information, on the contrary having a continuous data acquisition mechanism allows to have information also about low contrast environments. The downside is the amount of byte in information to be stored by the device. Such devices not only store the intensity of each pixel, but also the camera intrinsic and extrinsic characteristics, the depth and the inertial state information. Each matrix information constitutes a local map. The full state vector has a lot of dimensions, namely a huge covariance matrix 300kX300k. The next step is to optimize the matrix as to have minimal complexity: the depth is simplified by principal component analysis and the intensity is approximated by a diagonal matrix: each pixel has correlation only with its own intensity. What if the camera sensor produces a delayed observation? To effectively propagate uncertainties, it is useful to rely on Scattering Theory. The idea is to create a medium through which covariance measurements can be efficiently propagated: this approach reduces covariance calculation by 90% and assumes same linearization point for the covariance. Scattering theory is usually merged with Kalman filters to yield fast and consistent estimators.