In CL, teams of communicating robots estimate their poses (position and orientation) using proprioceptive data and relative pose measurements, resulting in an increment of the amount of data processed compared with single robot localization. Furthermore, it may overload the processing and communication channel. These drawbacks make unpractical real-time implementations with large team of robots. This is why, we focus on reducing the processing and communication complexity of CL. Particularly, we introduced a decentralized CL approach based on the Covariance Intersection (CI) algorithm which reduces the processing requirements from \(O(N^2)\) to \(O(1)\) per relative measurement. Moreover, it can handle asynchronous communication allowing operation in environments larger than the communication radius.

**Problem Statement**

- **Locate** a team of robots using available sensors’ data
- **Use** the interactions among robots by exchanging information

**Contributions**

- Introduced Covariance Intersection approach for CL that:
  - Reduce the processing and communication complexity of CL to \(O(N)\)
  - Each robot only maintains its own state and covariance
  - No need to know the cross-correlations between the robots
  - Handle asynchronous communication
  - Is provably consistent
  - Real-time implementation

**CI-based CL**

- Each robot \(R_i\) locally maintains an estimate for its own state and the corresponding covariance \(\hat{x}_i, P_i\).
- Whenever \(R_i\) observes \(R_j\) it computes \(R_j\)’s state-covariance \(\hat{x}_j, P_j\) using its local information.
- \(R_i\) sends to \(R_j\) the computed state-covariance pair, so \(R_i\) can fuse it with its own estimate \(\hat{x}_i, P_i\) using Covariance Intersection.

**References**
