Kolloquium

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Thema: Simultaneous Place Learning and Recognition for Bio-inspired Robotic Mapping

Abstract:

To operate autonomously in unknown environments, a mobile robot must be able to distinguish visited and unvisited places. The classical approaches aim to indirectly address this challenge by tracking landmarks in consecutive video frames so that the position error over the re-visited routes is minimized. In contrast, biological systems (including humans) navigate reliably through environments while primarily relying on visual cues, thus preserving the topological structure of the environment rather than precise geometry. In recent years, appearance-based mapping methods have gained substantial attention of the robotics communuity due to their ability to learn and recognize the appearance of a scene. Despite ample research in place recognition, a mainstream of stateof-the-art methods either require offline training, need prior knowledge of the target environment, or depend on extensive parameter tuning before the system is deployed in an environment.

To address the afore-mentioned shortcomings, this research focuses on online place learning and recognition. The biological aspect of this work is to exploit the strengths of the human vision and learning system (i.e. certain areas of visual cortex and hippocampus) so that the human-like representations of an environment can be extracted and learned incrementally. In scope of this work, a novel place learning and recognition algorithm is developed, which learns (on the fly) the topological structures between similar and dissimilar places while gradually discarding the spurious or noisy input. The developed system offers a robust bio-inspired place recognition solution for autonomous navigation in unknown environments with improved precision-recall rate compared to existing approaches. The performance of the algorithm is demonstrated on seven challenging benchmark datasets recorded at different times of the day, under extreme illumination conditions and dynamic objects.