Title: Spatio-Temporal Representation for Cognitive Control in Long-Term Scenarios

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Abstract:

The FP-7 Integrated Project STRANDS [1] is aimed at producing intelligent mobile robots that are able to operate robustly for months in dynamic human environments. To achieve long-term autonomy, the robots would need to understand the environment and how it changes over time. For that, we will have to develop novel approaches to extract 3D shapes, objects, people, and models of activity from sensor data gathered during months of autonomous operation.

So far, the environment models used in mobile robotics have been tailored to capture static scenes and environment variations are largely treated as noise. Therefore, utilization of the static models in ever-changing, real world environments is difficult. We propose to represent the environment's spatio-temporal dynamics by its frequency spectrum.

The spectral representation of the time domain allows to identify, analyse, and remember regularly occurring environment processes in a computationally efficient way. Knowledge of the periodicity of the different environment processes constitutes the model's predictive capabilities, which are especially useful for long-term mobile robotics scenarios. Experimental results gathered by a mobile robot over several months of autonomous operation indicate that the proposed approach allows to represent arbitrary timescales with constant memory requirements and reliably predict the future environment states [2]. The experimental results also demonstrate that in long-term scenarios, the proposed approach outperforms traditional methods based on static maps in tasks such as mobile robot self-localization and navigation [3].

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References:

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