Abstract:

We present a robot self-localization approach that is based on using a cascade of filters that increasingly refine a robot's guess regarding where it is in a hallway system. The location refinement carried out by each stage of the cascade compares a signature extracted from a stereo pair of camera images taken at the current location of the robot with a database of such signatures collected previously during a training phase. A central question in this approach to robot localization is what signatures to use for each stage of the cascade. An answer to this question must recognize the special importance of the first stage of the cascade - we refer to this as the prefiltering stage. The signature used for prefiltering must be significantly viewpoint invariant, while possessing sufficient locale uniqueness to yield a set of possible locations for the robot that includes the true location with a high probability. On the other hand, the signature(s) used for downstream filtering in the cascade must then prune away the inapplicable locales from the list yielded by the prefilter. What that implies is that the downstream filters must be increasingly viewpoint variant and locale specific. Although the framework we propose allows for an arbitrary number of filters to follow the prefiltering stage, the results we present in this paper are for a two-stage cascade consisting of a prefilter followed by one additional filter. The signatures we use in our experiments are based on 3D-JUDOCA features that can be extracted from stereo pairs of images. The proposed framework for choosing the best signatures for the prefiltering stage and the filtering stage that follows was tested in a large indoor hallway system with a total linear length of 1539 m. The validation results we show are based on a dataset of 6209 stereo images collected by a robot from the hallways during its training phase. The performance evaluation presented in this paper demonstrates that our framework can lead to - igh localization accuracy with good time performance by a robot.