A Unified Framework for Constrained Visual-Inertial Navigation

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Resume

Francesco Di Corato, PhD, Eng. in Automation and Robotics.

F. Di Corato received the Master of Science degree with honors in Automation Engineering at University of Pisa in October, 2008. In June, 2103 he received the PhD in Automation, Robotics and Bioengineering from the University of Pisa, with a Dissertation titled: "*A Unified Framework for Constrained Visual-Inertial Navigation with Guaranteed Convergence*". The PhD Thesis concerned the use of visual constraints to the problem of aided inertial navigation in unstructured dynamic environments and the probabilistic vision-based robust pose estimation of bodies with known geometry. He is currently working at University of Pisa as research assistant on Guidance, Navigation and Control of high performance underwater vehicles.

His research interests mainly concern aided inertial navigation, robust Bayesian filtering, the adoption of Computer Vision for the interpretation of the environment, Guidance, Navigation and Control of underwater vehicles and Entropy-based exploration. During his research activity, he was enrolled in National and International projects, mainly in the framework of guidance, navigation and control of autonomous vehicles. In the period January-July 2011 he was Visiting Scholar at Vision Lab – University of California, Los Angeles, under the supervision of prof. Stefano Soatto.

Abstract

Inertial navigation suffers from drifts due to several factors, in particular inertial sensor measurement errors. A viable alternative to classical aiding sensors used for *Aided Inertial Navigation* (integration with GPS, air data sensors, velocity loggers, …) is the adoption of a vision system that estimates the motion of the camera given a stream of successive images and image features tracked over time. Navigation via fusion of visual and inertial data is perhaps the most straightforward *inspired-by-Nature* approach, having direct evidences in daily living.

The presentation will be focused on the *loosely-coupled* fusion of visual and inertial data for autonomous navigation, by using visual measurements in the form of implicit constraints. A brief overview of the general problem of visual-inertial navigation will be given, together with a review of the most relevant approaches in the literature. The following discussion will largely concentrate on constrained visual-inertial navigation: in particular the convergence properties of the estimation, some implementation and robustness issues, the constrained optimal estimation schemes for the fusion of the inertial measurements with the visual measurements will be covered. The results presented will be supported with simulative and experimental results.

It is assumed that the audience has a background in mathematics, with some concepts of continuous/discrete-time dynamical systems, reference systems transformation and few notions of stochastic processes and optimal filtering (The discussion will be concentrated on the use of the Constrained Kalman Filter).

Main References

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