

Global-scale Localization in Outdoor Environments for AR

Organizers

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Abstract

In this tutorial we aim for a review of existing technologies to perform outdoor localization in urban environments at a global level in full 6DOF using visual sensors primarily. The goal is to provide a clear overview about the current state-of-the-art in global positioning and orientation estimation, which includes a wide range of methods and algorithms from both the Computer Vision and the Augmented Reality community. The main focus is put on methods that are real-time capable, or can at least be applied through a server-client infrastructure. Algorithms that are based on single images, panoramic images, as well as SLAM maps and sparse point cloud reconstructions from SfM will be discussed, together with mobile hardware considerations.

The attendees will acquire an overview about the current landscape of technologies employed to facilitate outdoor localization for AR. The tutorial should enable them to get a feeling for the current state-of-the-art of methods for outdoor Augmented Reality.

Schedule

9:00 - 9:05	Welcome and Introduction
9:05 - 10:05	The Localization Continuum - A literature review (1 hour) Terminology and Synonyms found in the Literature. What's the difference between in- and outdoor scenarios? What is required and what can be expected given sensors? Indoor versus Outdoor tracking, 3DOF from sensors vs. 3DOF from images, 6DOF from sensors vs. 6DOF from images.
10:05 - 10:20	Break
10:20 - 11:20	Modern Computer Vision and its application to AR (1 hour) The standard way of doing it: SfM and 3PP. An introduction. Beyond sparse features – the use of lines and other geometric primitives – discussing the correspondence problem in detail. 2D and 2.5D maps – how they can be used for localization and how synergies can be used for AR. Confluence of AR content and CV need. Solved vs. unsolved problems. What situations do we have a solution for and for which we don't have one.
11:20 - 11:35	Break
11:35 - 12:35	Mobile Hardware: Constraints, opportunities and usability considerations (1 hour) Processor speed, storage, and power requirements - what are the most expensive parts of localization approaches in these terms? The hardware spectrum: from ultra-low power smart cameras to smartphones, tablets and UMPCs. Relying on the cloud: what's the benefit and the drawback of using remote servers. What's the trend in hardware as we can foresee it, and which developments help for solving the localization problem? Usability considerations — how different interface configurations might enable different localization algorithms (e.g. iPhone vs, tablet vs, Google Glass).
12:35 - 12:50	Concluding Remarks and Discussion

Form Of Presentation

The tutorial will be presented through several speakers with the support of visual aids in the form of PowerPoint slides.

Intended Audience

The target audience would range from anyone working, researching or planning to work in the field of AR. The tutorial at times will require a moderate degree of technical understanding.

Instructor Background

Clemens Arth, *Graz University of Technology*, arth@icg.tugraz.at

Clemens is a senior research scientist at Graz University of Technology, focusing his research on computer vision methods for outdoor localization in Augmented Reality, publishing several papers on this topics at recent ISMAR conferences in the last few years.

Jonathan Ventura, *University of Colorado Colorado Springs (UCCS)*, jventura@uccs.edu

Jonathan is an assistant professor at UCCS. His research focus is developing computer vision techniques for mobile AR. He is especially interested in vision-based modeling and camera localization. The goal of his work is to enable sophisticated and widely available mobile augmented reality experiences through advanced sensor technology.

Dieter Schmalstieg, *Graz University of Technology*, schmalstieg@tugraz.at

Dieter is a full professor and head of the Institute for Computer Graphics and Vision at Graz University of Technology. His current research interests are augmented reality, virtual reality, computer graphics, visualization and human-computer interaction.