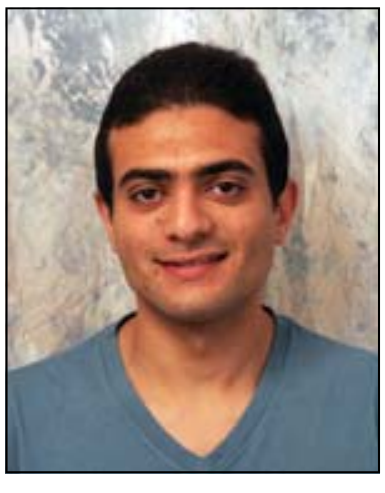
Field Robotics Center Seminar Series

Friday, April 15, 2011 NSH 1507 2pm - 3pm



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Special Seminar

Stereo Visual Odometry for Pipe Inspection

Abstract

Liquid Natural Gas (LNG) processing facilities contain large complex networks of pipes of varying diameter and orientation intermixed with control valves, processes and sensors. Regular inspection of these pipes for corrosion is critical for safety. Popular existing non-destructive technologies that used for corrosion inspection in LNG pipes include Magnetic Flux Leakage (MFL), radiography (X-rays), and ultrasound among others. These methods can be used to obtain measurements of pipe wall thickness, and by monitoring for changes in pipe wall thickness over time the rate of corrosion can be estimated. For LNG pipes, unlike large mainstream gas pipelines, the complex infrastructure means that these sensors are currently employed external to the pipe itself making comprehensive, regular coverage of the pipe network difficult to impossible. As a result, a sampling-based approach is taken where parts of the pipe network are sampled regularly, and the corrosion estimate is extrapolated to the remainder of the pipe using predictive corrosion models derived from metallurgical properties. We argue that a robot crawler that can move a suite of sensors inside the pipe network, can provide a mechanism to achieve more comprehensive and effective coverage.

In this talk, we present a stereo visual odometry system capable of creating high resolution, sub-millimeter accuracy maps of internal pipe surfaces. Such maps provide both 3D structure and appearance information that can be used for visualization for inspection and corrosion detection tasks, as well as cross registration with other sensory data. We detail hardware and software design that enable us to obtain high accuracy visual odometry estimates. Design considerations include the development of a verged stereo head with a polarized light source and lensing to cope with specular reflections and the use of stereo-based Bundle Adjustment for optimal refinement of camera pose and structure. Finally, we show empirical results from a range of datasets collected inside real pipes as well as outdoors to demonstrate and validate the performance of our approach.

Speaker Bio

Hatem Alismail is a Masters student at the Robotics Institute, advised by Brett Browning and Bernardine Dias. His research interests include the utilization of computer vision for navigation and mapping for mobile robots, and technology for developing communities.

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