Systems and Control Seminar
Fujita and Hatanaka Group
Tokyo Institute of Technology

Opto-Acoustic Distance Measurement Using Spread Spectrum Techniques and Carrier Phase Measurements

Friday, December 11th, 2015 17:00-18:00 S5-306B

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Abstract

In this talk, a novel opto-acoustic device for linear indoor distance measurement is presented. This device forms the key element of an indoor navigation system, which employs multilateration in order to estimate the position and orientation of a rigid body based on multiple linear distance measurements. The device presented in the talk uses a two channel link between a sender and a receiver. One channel employs modulated infrared light, the other ultrasound as transmission medium. That way, the system does not interfere with human perception. The distance measurement relies on a method similar to the flash-to-bang principle, which is used to estimate how far a thunderstorm is away. As light propagates almost instantly, the time delay between infrared (flash) and ultrasound (thunder) is directly proportional to distance. However, opposed to the rather simple flash-to-bang method, our device uses Gold codes to modulate the ultrasound and infrared signals. Correlation of the received envelopes then yields a robust, unique but coarse distance signal. On top of that, the raw carrier signals of the infrared and ultrasound signals are also considered. The carrier phase difference provides a highly accurate distance measurement, which is however ambiguous with respect to wavelength. Both distance signals are therefore complementary. In the talk, experimental results are presented. They show that a measurement resolution in the submillimeter range is feasible.