Center of Excellence in Intelligent Engineering Systems

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Speaker: Dr. Muhammad Bilal

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Muhammad Bilal received B.S. Electronics Engineering from G.I.K Institute of Engineering Sciences & Technology, Pakistan in 2002 and M.S. Computer Engineering and Ph.D. Electrical Engineering from Lahore University of Management Sciences, Pakistan in 2007 and 2013, respectively. He worked in Center for Integrated Smart Sensors (CISS) at KAIST, Korea as a post-doctoral researcher before joining CEIES and the Department of Electrical and Computer Engineering at King Abdulaziz University in 2014. His research interests include system design for image and video processing applications, approximate arithmetic circuits and embedded systems.

Date: **Monday, November 23, 2015**

Time: **1:00PM**

Venue: **Engineering Building, Second floor, Room 24C28 (ECE Seminar Room)**

Title

Resource-Optimized Implementation of UAV Flight Control Software on a DSP without Kernel Support

Abstract

Flight Control System (FCS) or Autopilot of an autonomous UAV is a complex, highly integrated system that achieves the desired goals (smart sensor data acquisition and fusion, navigation, guidance, multiple dynamic controls, telemetry, data logging and payload management) while maintaining the desired performance in terms of energy conservation, fault diagnosis and tolerance etc. These processes and operations are not essentially synchronized and/or running at same speed. Therefore, real-time execution of such a complex system requires efficient resource management and timing schedule. Common platforms of choice for implementing an FCS are microcontrollers, DSPs, ASICs and FPGAs etc. The limited cost and energy budget of a typical UAV does not allow commissioning of highly resourceful and expensive machines. On the other hand, with limited computational resources onboard, real-time performance target may not be met. Recently, cheap yet extremely resourceful, compact and power efficient embedded controllers have appeared with flexible development tools making it conducive to design highly capable FCS at low cost quickly. TI®'s Delfino® Dual-Core F28377D is one such highly resourceful and cheap DSP microcontroller with dual-core 32-bit CPUs, floating point units, co-processors to accelerate trigonometric math operations and separate Control Law Accelerators (CLA). FCS implementation on such a platform poses an extreme challenge in the form of optimal resource utilization requiring critical decisions related to source coding, memory utilization and peripheral management. An efficient resource utilization scheme ensures availability of critical onboard resources for more elaborate system designs for future expansion. Kernel-supported software approach relieves the system designer from making minute hardware related configurations but does so at the cost of increased pressure on available memory and CPU resources. Therefore, to avoid this overhead, a bare-metal/stand-alone implementation is suggested. This approach allows direct control of the onboard resources keeping the time management a top priority. Resultantly a highly optimized implementation is possible with transparent access to all the available resources.

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