



TEXASTECHUNIVERSITY

Edward E. Whitacre Jr. College of Engineering

Computer Science

Angles between Subspaces with Applications and Model Predictive Control with Accuracy Analysis

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Abstract

Principal angles between subspaces (PABS) (also called canonical angles) serve as a classical tool in mathematics and statistics for various applications (e.g., data mining, subspace classification, information retrieval, random processes, face recognition, and system identification). My work on PABS focuses on its property, computation methods, and its application in the accuracy of eigenvalues. Several error bounds for accuracy of eigenvalue approximations by the Rayleigh-Ritz (RR) method are derived. Those bounds of eigenvalues influence the development of mathematical software for a highly accurate solution of eigenvalues problems. Model predictive control (MPC) can efficiently control constrained systems in real-time applications. MPC feedback law for a linear system with linear inequality constraints can be explicitly computed off-line. An actual implementation of this explicit MPC in low cost micro-controllers requires the data to be “quantized”, i.e., represented with a small number of memory bits. An aggressive quantization decreases the number of bits and the controller manufacturing costs, and may increase the speed of the controller, but reduces accuracy of the control input computation. We derive upper bounds for the absolute error in the control depending on the number of quantization bits and system parameters. The bounds can be used to determine how many quantization bits.

Bio

Dr. Peizhen Zhu joined the Department of Computer Science at Missouri University of Science and Technology as an assistant teaching professor in August 2017. Before that, she had been an assistant teaching professor in the Department of Mathematics and Statistics at the same university for three years. She received her Ph.D. in Computational Mathematics from University of Colorado Denver in December 2012. After graduation, she worked as a professional research assistant with Prof. Julien Langou in University of Colorado Denver for one year. Then she was a visiting research member staff in Mitsubishi Electric Research Laboratories (MERL) for less than one year. Her research interests span a range of areas related to numerical linear algebra, optimization, graph algorithms, data mining, matrix analysis, eigenvalue, model predictive control, and machine learning.