*ACM Distinguished Speaker Series Talk*

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TEXAS TECH UNIVERSITY Department *of* Computer Science

# Towards Bridging the Computer Science-Control Theory Divide

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Zoom

**Abstract:** Modern cars have hundreds of millions of lines of software code running on 100-200 processors embedded in them. They implement a variety of safety critical, driver assistance, and comfort-related functions. Give or take, this is also the case in modern robots and industrial production systems. The algorithmic core of such code is made up of multiple feedback-control loops designed using well-established techniques from control theory. But the design of such controllers traditionally rely on many simplifying assumptions like unbounded numerical accuracy, that the control input can be computed instantaneously, there is no delay from sensing to actuation, and that all the plant states can be sensed concurrently. While many of these assumptions were approximately true in the past, as control strategies and the computer hardware on which they are implemented are becoming more complex, these simplifying assumptions are increasingly not true.

As a result, there is a widening divide between control theory (using which the control laws are designed) and computer science (using which the laws are implemented as software). A consequence of this being that the control software no longer behaves as required by the control designer. Further, while control theory is concerned with issues like stability and performance metrics like settling time or peak overshoot, computer science is concerned with efficient implementation of algorithms. Here, "efficiency" refers to the optimal use of computation, communication, and memory resources. However, control theory is not equipped with such notions of efficiency. Hence, efficient implementation of control software is jeopardized by computer science notions of efficiency not being accounted for during the controller design stage.

Bridging these gaps requires new mathematical results that can substantially improve the design and reliability of software for future cars, robots, and a host of similar engineering systems. This talk will attempt to provide an introduction to this missing mathematics.

**Bio:** Samarjit Chakraborty is a William R. Kenan, Jr. Distinguished Professor and Chair of the Computer Science Department at UNC Chapel Hill. More details may be found here:
[https://cs.unc.edu/person/samarjit-chakraborty/](https://cs.unc.edu/person/samarjit-chakraborty/)