

## The ranks of tensors and their applications

Thomas Karam  
*Shanghai Jiao Tong University*  
thomaskaram@sjtu.edu.cn

This talk will address the ranks of tensors, notions of complexity on tensors that extend the matrix rank each in their own way. The ranks of tensors have been successfully applied to several areas such as (among many more others) communication complexity, circuit complexity, quantum information theory, data compression, machine learning, and network analysis, yet despite that, much of the basic understanding of these ranks is still in its very early stages. We will begin by recalling the origins of some of the rank notions on tensors (such as the tensor rank, the slice rank, the partition rank, the R-rank and the subrank) as well as some of the above applications. Next, we will review some of the major advances in the accelerating development of the basic theory of the ranks of tensors that have been witnessed by the last ten years, and in turn some of the resulting improvements in applications. Thereafter, we will focus specifically on the extension of several basic properties of the rank of matrices to the ranks of tensors: first on which generalisations hold for all tensors, and then on how they may be qualitatively strengthened further for specific classes of tensors. Finally, we will outline directions of research that we believe would make progress on central difficulties behind several basic but open questions regarding these ranks.