Representation and coding of signal distances: Comparing signals in the cloud

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Classical signal representation theory and practice have focused on how to best represent a signal as efficiently as possible, and minimize the distortion on the signal incurred by the representation. However, in many applications the processing stage only requires the extraction of specific information from the signal and the signal itself is not necessarily of interest. In such applications the representation should be information scalable, i.e., adaptable to efficiently representing only the information required by the processing and nothing superfluous. In an increasingly data-intensive and cloud-based world, any non-scalable approach can rapidly become unsustainable. Information scalability further ensures that the processing party can only extract limited information from the representation, as necessary to perform the desired function. Such a limitation may often be sufficient to provide privacy guarantees to the user—increasingly important in the modern interconnected world.

In this talk, motivated by cloud-based image-retrieval applications, I demonstrate that such information scalability can often be achieved using appropriately designed signal embeddings. Combined with quantization, these embeddings are a perfect fit for inference applications with storage, processing or communication constraints, such as augmented reality. These embeddings capture all or part of the geometry of the signal space, as required for inference, at a very low bit-rate. As a consequence, the storage or transmission rate can be reduced by more than 95%, compared to transmitting an image, and more that 50% compared to existing approaches for image retrieval. In addition, these embeddings provide strong information-theoretic privacy guarantees, making them appropriate to privacy-sensitive applications such as biometric authentication.

Bio:
Petros T. Boufounos is a Principal Member of Research Staff at Mitsubishi Electric Research Laboratories (MERL) and a visiting scholar at the Rice University Electrical and Computer Engineering department. Dr. Boufounos completed his undergraduate and graduate studies at MIT. He received the S.B. degree in Economics in 2000, the S.B. and M.Eng. degrees in Electrical Engineering and Computer Science (EECS) in 2002, and the Sc.D. degree in EECS in 2006. Between September 2006 and December 2008, he was a postdoctoral associate with the Digital Signal Processing Group at Rice University. Dr. Boufounos joined MERL in January 2009.
Dr. Boufounos' immediate research focus includes signal acquisition and processing, frame theory, quantization and data representations. He is also interested into how signal acquisition interacts with other fields that use sensing extensively, such as machine learning, robotics and mechatronics. Dr. Boufounos is a Senior Area Editor at IEEE Signal Processing Letters. He has received the Ernst A. Guillemin Master Thesis Award for his work on DNA sequencing, the Harold E. Hazen Award for Teaching Excellence, both from the MIT EECS department, and has been an MIT

Presidential Fellow. He is also a senior member of the IEEE and a member of Sigma Xi, Eta Kappa Nu, and Phi Beta Kappa.