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Neural network based compressive sensing and its application to SHM of civil infrastructure

Data fusion and multi-type sensor placement in structural health monitoring (SHM) are promising techniques for reliable estimation of current condition of the civil infrastructure. Unfortunately, in large scale structures equipped with a variety of sensors one needs to address the transmission and storage challenges associated with big data gathered during measurements. One way to avoid the overwhelming amount of information is to reduce the spatial resolution and optimize distribution of sensors. The other way is to reduce sampling frequency over a heterogeneous network of sensors. Compressive sensing (CS) is an efficient tool for reducing the sensor sampling rate, which is especially important in structural health monitoring of civil infrastructure. However, practical issues with the sampling and reconstruction algorithms prevent vast development of CS in real world engineering structures. Deep learning (DL) allows better flexibility of CS for adapting the sampling matrix, reconstructing the signal, and learning from the compressed samples. While the integration of deep learning and compressive sampling received recently significant research interest, it has not yet fully clarified what kind of neural networks architectures are best suited for such problems. In this paper main types of neural architectures will be discussed and preliminary results for the implementation of DL based-CS on tied-arch bridge equipped with heterogeneous network sensors will be presented.