



Department of Mathematics  
Faculty of Science

## **Research Highlight: Siamese cooperative learning for unsupervised image reconstruction from incomplete measurements**

**Hui, Ji; Tongyao, Pang; Xinran, Qin; Yuhui, Quan**

(authors listed in alphabetical order)

In the realm of imaging science, reconstructing images from incomplete measurements is a fundamental challenge. Traditional supervised deep learning methods, while effective, rely heavily on extensive datasets of latent images, limiting their applicability in situations where such data is scarce, such as in scientific and medical applications. These constraints necessitate alternative approaches that can work effectively with limited data.

In this paper, we present an innovative unsupervised deep learning approach designed for scenarios with restricted access to latent images. The proposed method developed a Siamese network with twin sub-networks that collaboratively reconstruct images in complementary spaces: the null space of the measurement matrix and the range space of its pseudo-inverse. This network is trained using a self-supervised loss with rigorous mathematical justification. Applied to four distinct imaging tasks, the method demonstrated superior performance compared to existing unsupervised techniques, showing its potential to significantly advance image reconstruction in data-limited environments.

### **References:**

Y. Quan, X. Qin, T. Pang, and H. Ji, Siamese cooperative learning for unsupervised image reconstruction from incomplete measurements,

IEEE Transactions on Pattern Analysis and Machine Intelligence, 46 (7), 4866-4879, July 2024