Images are a rich source of beautiful mathematical formalism and analysis. Indeed, mathematics is the foundation for various image analysis tasks, including image denoising and deconvolution, image reconstruction from indirect measurements as they appear for instance in computed tomography, image segmentation and classification, just to name but a few. Associated mathematical problems arise in functional and non-smooth analysis, the theory and numerical analysis of partial differential equations, harmonic, stochastic and statistical analysis, and optimization and machine learning.

Starting with a discussion on the intrinsic structure of images and their mathematical representation, this talk will address some of these mathematical problems, including variational models for image analysis and their connection to partial differential equations and a new paradigm in mathematical imaging using deep neural networks. The talk is furnished with applications to art restoration, forest conservation and cancer research.

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