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## **Mathematics in Image Processing**

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### **Outline**

In our everyday life, we became accustomed to take pictures using digital cameras or mobile phones, to have high quality medical images, to observe cosmologic or microscopic pictures, to watch movies involving special effects and computer animation. As Jay Cassidy, a film editor at Mathematical Technologies Inc., put it, “We’re in Act I of a digital revolution.”

These exploits involve a lot of mathematics. More lighting achievements are to come, thanks to the continuous progress and the interactions between various mathematical fields—PDE’s, modeling, harmonic analysis, optimization, numerical analysis, scientific computing, control and game theory, learning and information theory, among others.

Numerous imaging problems are defined as the solution of an optimization problem. There reside a still open fundamental question: how to define an optimization problem so that its solution satisfies the specific requirements of the imaging application at hand? Years ago we realized that a rigorous basis to construct such an optimization problem relies on a good knowledge of the essential features exhibited by its solutions. One could retort that it’s like a Gordian knot... Nonetheless, it appeared workable and many results—both theoretical and practical—were obtained in this way. An intrinsic mutual relationship between optimization and modeling is thus established. My talk will give a flavor of the rich possibilities offered by this standpoint.

Let us note that these possibilities extend far beyond image processing.