THE GEOMETRY OF SIMPLICITY

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A revolution is underway in how information is collected and analysed. Traditionally, vast amounts of data are compiled, the essential features are extracted, and the remaining data disposed of. For instance, the resolution of digital cameras is rated in terms of millions of pixels (points) measured, whereas a resulting image is typically less than one megabyte in size - indicating that 90% of the measured information was discarded. In late 2004 the Compressed Sensing paradigm was introduced in which the essential features are measured directly. This is achieved by replacing traditional point samples with randomized sampling and a novel reconstruction algorithm. For applications where the measurement process is "costly," Compressed Sensing allows for dramatic improvements in efficiency.

Preliminary application of Compressed Sensing to MRI has yielded high-quality dynamic visualisation of the beating heart. For this application, achieving the maximum information extraction rate is crucial as the measurement acquisition is time-limited due to patient respiration which degrades image quality. With the dramatic advances Compressed Sensing suggests, a host of other applications are already being investigated including distributed network sensors, the analysis of mRNA lengths, and next generation Analog-to-Digital converters to name a few. These striking early applications along with deep mathematics connecting diverse areas of pure and applied mathematics has generated a ferment of interest, inducing researchers from abstract mathematical areas such as Banach spaces to begin collaboration with experts in signal processing and circuit design.