Precision Imaging

From Population Imaging Analytics to In-silico Clinical Trials

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Medical image computing is witnessing exciting times. Specifically to this talk, new opportunities and challenges have emerged with the growing availability of large population imaging repositories being collected in the UK, USA, Canada, Germany, and The Netherlands, to name Just a few.

Against this backdrop, we are interested specifically in developing new methods for and applications of Precision imaging to maximally exploit the wealth of information behind large imaging repositories and associated meta data. Precision imaging is not a new discipline per se but rather a distinct emphasis in medical imaging and image computing borne at the crossroads between, and unifying the efforts behind mechanistic and phenomenological model-based imaging and image computing. Precision imaging fundamentally recognizes the need for both data-driven and hypothesis-driven approaches to image analysis and image-based modeling.

The exponential rate at which data availability is growing will rapidly outpace the exponential growth rate of available computational resources and is never sufficiently abundant to deal with the combinatorial complexity intrinsic to many disease mechanisms. As described by Helbing, this implies the problem of "dark data", i.e. the share of data we cannot process is increasing with time. Consequently, we must know what data to process and how which requires science. Anderson's vision of big data (i.e., assuming we will not need theory and science anymore) is unlikely to prevail. Artificial intelligence will unlikely change this situation fundamentally.

Precision lmaging captures three main directions in the effort to deal with the information deluge in imaging sciences, and thus achieve wisdom from data, information, and knowledge. Precision lmaging is finally characterized by being descriptive, predictive and integrative about the imaged obJect. This paper provides abrief and personal perspective on how the field has evolved, summarizes and formalizes our vision of precision imaging for precision medicine, and highlights connections with past research and current trends in the field.