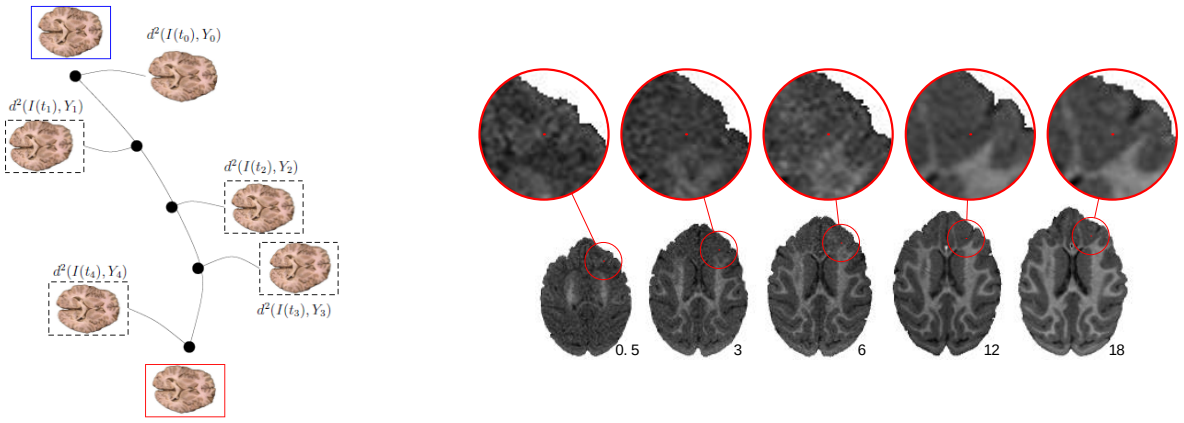
Image Registration: Analysis of Time-Varying Image Data

Department of Computer Science **University of North Carolina at Chapel Hill** **March 2014**

The most basic and fundamental tools for signal processing are filtering, smoothing, and regression, followed by or combined with an interpretation of the so-processed signals: signal analysis. While these methods are very advanced for scalar-valued data, the theory and methodology is much less developed, but of equal importance, for time-varying images, where one needs to be concerned with the spatial alignment of images (so-called image registration).

We are developing computational methods to extend methods such as linear regression, or spline models to appropriately deal with image-valued data. We are also working on registration methods capable of aligning images containing pathologies (such as brain-tumors) and images, which change appearance over time. Application areas for such models are diverse and span medical as well as computer vision applications. For example, in medical image analysis such models can be used to capture changes during brain development and to compare and summarize changes over time for individual subjects. Such models may also be used to predict likely brain changes for individuals and to compare subject populations: for example to distinguish subjects with dementia from healthy subjects. We are currently using these methods to study normal brain development in the macaque monkey. As the developed theories are general they also have computer vision applications for example for people counting from surveillance videos or in general to extract information from video sequences.



Left: Principle of "geodesic regression": generalizing linear regression to image-valued data.
Right: Appearance changes across time are highly relevant for an appropriate analysis as seen in this developing macaque (with age in months).

Participating Departments: Computer Science, Psychiatry
Leaders: M. Niethammer, M. Styner