

数学与系统科学研究院

计算数学所学术报告

报告人: **Prof. Ke Chen**

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报告题目:

**Diffeomorphic Image Registration by
a deep learning method using
variational models**

邀请人: 优化与应用研究中心

报告时间: **2019年7月4日 (周四)**

上午 10:00-11:00

报告地点: **数学院南楼六层**

602 教室

Abstract:

Image registration is a core problem in Imaging and Data Sciences. Although many models and computational algorithms have been developed in recent years, it remains a big challenge to achieve both an accurate solution and fast speed for real time applications. In this talk, after reviewing a few classes of models, we discuss the deep learning framework. To offer wider applicability, we consider the scenario where ground-truth deformation fields are not available for training. We propose that the deformation fields are self-trained by a variational model compromised by an image similarity metric and a regularization term. The latter builds in a constraint on the determinant of the transformation in order to obtain a diffeomorphic solution.

The proposed algorithm is first trained and tested on synthetic and real mono-modal images. The results show how it deals with large deformation registration problems and leads to a real time solution with no folding. It is then generalized to multi-modal images. To improve the robustness, we combine the deep learning algorithm with a pre-processing approach. The initial given pair of images, which are non-linearly correlated, are first processed and optimized to serve the purpose of intensity or edge correction. This pre-processing step is based on the reproducing Kernel Hilbert space theory and yields intermediate new images which are more strongly correlated than the original ones and which will be used for training the model. Initial experiments and comparisons with learning and non-learning models demonstrate that this approach can deliver good performances and simultaneously generate an accurate diffeomorphic transformation.

Short Bio:

陈柯教授，现为英国利物浦大学终身教授，皇家御批数学家，英国国家基金委利物浦数学与健康科学研究中心（英国 5 中心之一）主任，利物浦大学物理科学院主管国际化的副院长，南昌大学特聘讲座教授。83 年毕业于大连理工大学，与 87 和 90 年分别取得英国曼彻斯特大学和普利茅斯大学硕士和博士学位。在加盟利物浦大学前，曾在英国里丁大学从事 3 年博后工作。他在 2003-2006 间，先后在加州大学洛杉矶分校和香港中文大学做访问教授。2014 年选入辽宁百人计划。他的研究领域广泛：包括科技计算，快速算法，微分和积分方程数值，近年来主要研究图像处理中各种反问题的模型构造，算法和应用。发表论文 160 多篇包括 120 多篇专业杂志文章和 90 多篇 SCI 文章与书籍。现为 3 个国际数学杂志的编委。他目前是 Springer-Nature 出版社“图像与视觉中数学模型与方法”手册(2020)的主编。

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