Post-doctoral Position on Lung CT Image Analysis at Columbia University

Columbia University's Heffner Biomedical Imaging Laboratory (http://hbil.bme.columbia.edu) has an opening for a post-doctoral fellow in the field of Medical Image Analysis. The position is initially offered for 1 year and can be extended for up to 1 year total. The Position will be open until filled; with an ideal start date in December 2015 or January 2016.

Context of the project:
This position is part of an ongoing R01 NIH project between the Departments of Biomedical Engineering (Prof Andrew Laine, co-PI) and the Department of Medicine (Prof. Graham Barr co-PI) at Columbia University.

Description
The Heffner Biomedical Imaging Laboratory at Columbia University is seeking a postdoctoral fellow to build upon already developed and design new state-of-the-art image analysis tools for the identification and validation of quantitative emphysema subtypes – based on 1,000s of CT scans from 3 gold-standard studies. Emphysema is a complex and evolving disease, which leads to changes of the normal lung parenchyma texture on CT images. These changes take multiple forms and are evolving in time. This project proposes to use an unsupervised learning approach to cluster localized texture patterns and discover quantitative emphysema subtypes. Demonstration of the clinical significance of these subtypes will include analysis of variations among normal subjects, correlation with respiratory symptoms, and prognostic significance for adverse events and longitudinal progression rate. Exciting challenges in this project include: handling 1,000s of scans acquired on heterogeneous sets of scanners, reconciling measures made on full-lung and cardiac scans, reconciling measures made on research-quality and clinical CT scans, and pursuing a discovery-based approach exploiting unsupervised learning only.

Keywords on methodological approaches:
The image processing tools being developed rely on two types of methods:
- **Hidden Markov random field** for the segmentation of emphysematous voxels [3], exploiting parametric models of intensity distributions and scanner-specific or subject-specific parameterization.
- **Patch-based** analysis of **textures**, **scale-space** image features extraction, **graph** partitioning of cost metrics and optimization of **unsupervised clustering** objective functions [2].

In addition, given the large heterogeneity in scanner types and reconstruction filters, there are some needs to use tools [1] targeting image **denoising**, noise estimation, intensity **calibration**, and intensity gradient correction.

Finally, given the large dimension of the database and the need to correlate image-based findings with physiological and genetic data, this project will integrate **big-data analytics** in the coming year.

Previous publications from the project:
Education:
The candidate should have a PhD in a field related to medical imaging or computer vision. Previous experience with machine learning, medical statistics, and/or parallel computing is a plus. Good communication skills and ability to work in a multidisciplinary environment are important.

Application:
Interested candidates should send a CV with a complete list of publications, statement of research interests and two references to Dr. Andrew Laine (al418@columbia.edu) and Dr. Elsa Angelini (ea179@columbia.edu).