Postdoctoral Research Position within Medical Image Analysis

The Image Group at the Department of Computer Science (DIKU), University of Copenhagen, Denmark, has an opening for a postdoctoral researcher on the project "Statistical Machine Learning Methodologies for Designing Efficient Biomarkers – Learning Imaging Biomarkers". The Post.Doc is expected to develop new machine learning technologies for supervised and semi-supervised learning that will allow the design of efficient imaging biomarkers while reducing the number of patients in clinical trials, reducing the time between screening, while being more reliable than traditional markers. Additionally, the research should pursue discovery of new pathology-related relationships through machine learning of multiple biomarkers (adding non-imaging biomarkers).

The initial position is for one year but may be extended.

At the Department of Computer Science, two faculty members are associated with the project and nine PhD students are/will be working within the project: seven within the development of imaging markers for Osteoarthritis, Osteoporosis, Cardiovascular Calcification, and Breast Cancer Risk respectively and two within Shape Modelling and Machine Learning respectively. The postdoctoral researcher is expected to perform research in close collaboration with the other project members.

Qualifications

The candidate should have either a strong background in medical image analysis or computer vision and have affinity with machine learning or pattern recognition or vice versa and have a strong interest in bridging the gap to medical/biological research. Additionally, [s]he should feel comfortable with mathematics and statistics. The applicant should have good, demonstrated skills in written and spoken English. A PhD in a relevant discipline is a necessity.

Short Project Description

The project aims to develop new machine learning technologies for supervised and semi-supervised learning that will allow the design of efficient imaging biomarkers while reducing the number of patients in clinical trials, reducing the time between screening, while being more reliable than traditional markers. The design of efficient biomarkers is capital for accurate patient diagnosis, prognosis and disease progression. With medical imaging technologies used in clinical trials, a huge amount of data is available, which size generally prevents a direct use of it. In order to develop these markers, not only a precise biological understanding is necessary, that will guide the development of image analysis tools for the extraction of the relevant data, but also a precise modeling of the data that allows for statistical exploitation of it. We will concentrate on the extraction of shapes and appearances and the development of geometrical models that allow to compute similarity measures on them from which learning machines can be trained, the resulting biomarker quality being assessed by correlating with other data acquired during clinical studies.

Submission of applications

The application must contain

- Curriculum Vitae incl. list of publications
- Up to three scientific publications selected for evaluation
- Project proposal outlining what the applicant wants to achieve during the period as a post doc (max. 2 pages)
- PhD assessment committee's provisional or final evaluation
- A copy of the PhD diploma

All interested candidates irrespective of age, gender, race, religion or ethnic background are invited to apply. The application must be submitted by e-mail to francois@diku.dk and madsn@diku.dk and be received no later than 22 September 2008 at 12.00 noon CET.

Contact Persons

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6 PhD scholarships within Medical Image Analysis

The eScience Center, University of Copenhagen, Denmark invites applications for 4 PhD scholarships and 2 Industrial PhD scholarships in medical image analysis which are funded by Nordic Bioscience A/S and the Programme Commission on Strategic Growth Technologies. The scholarships are available in collaboration between Nordic Bioscience A/S and the Image Group at the Department of Computer Science, University of Copenhagen (DIKU).

The eScience center at the University of Copenhagen was established in 2007 in order to concentrate the activities within computational science at the Faculty of Natural Science. Currently, app. 30 people hold positions in the center and a similar number of scientists are associated with the center and involved in collaborative projects. More information may be found at www.eScience.dk.

The scholarships relate to six existing collaborative projects between the above-mentioned partners: 4 on development of imaging markers for osteoarthritis, osteoporosis, cardiovascular calcification and breast cancer risk respectively and 2 within shape modelling and machine learning respectively.

Project 1: Multi-Tissue Analysis of Shape & Structure - Coupling of Bone and Cartilage in Osteoarthritis
A major challenge in OA is to discover the nature of the local and global couplings between bone and cartilage during disease progression. For this analysis, a quantitative model of shape and structure covering several cartilage and bone compartments is needed. In our OA group, we already have interesting results on fully automatic analysis of cartilage from MRI and we are currently expanding our research focus to bone as well. We also have a tight collaboration with our group of molecular biologists that provide clinical insight and biochemical biomarkers for use in machine learning tasks. We have several data collections available with MRI and radiographs for 1000+ subjects.

Project 2: Morphology and Density Analysis of Aortic Calcified Deposits
Calcified deposits in the aorta are visible on standard lateral X-rays. Recent research shows that the distribution, morphology and density of these relate closer to CVD risk than simple measures based on amount alone. In this project, the automatic image analysis methods of identifying calcified deposits and machine learning methods for data mining large datasets will be used to define new markers that relate to patient prognosis. Large datasets with >8000 patients are available for the studies.

Project 3: Analysis of vertebral shape and appearance for prognosis and quantification of osteoporosis
During osteoporosis, the individual vertebrae risk to compression fracture. Recent research shows that an analysis of the full shape of the individual vertebrae and the spine are more indicative than simple height measures in standard clinical use. In this project, we will use the relative shape of the individual vertebrae, their appearance and the shape of the full spine to identify indicative markers of osteoporosis risk and

to quantify the progression. Large datasets with >8000 patient are available for this project.

Project 4: Breast cancer risk assessment by shape and texture.
It is well known that breast density relates to breast cancer risk. Recent research documents that the mammographic texture independently also relates to breast cancer risk. In this project, we will identify local image structure by means of texture analysis that relates to breast cancer risk. The methods used will be machine learning methodologies for feature selection and dimensionality reduction.

Project 5: Shape modelling
In order to exploit shape information from datasets of patients, there is a need for developing mathematical and computational models of shapes and shape spaces. These models should capture the relevant shape information and variations and allow to perform statistics on these spaces. The methods used will be geometric, with focus on differential geometry, in particular Riemannian manifolds, ordinary and partial differential equations, statistics of manifolds.

Project 6: Machine learning
In order to derive most informative aspects of shapes or appearances for specific biological questions used to build imaging biomarkers, statistical machine learning methodologies will have to be adapted to non linear feature spaces of shapes and appearances such as Riemannian manifolds. The methods used will be unsupervised, supervised and semi-supervised statistical machine learning, differential geometry and optimization on manifolds. Especially learning of and on manifolds and low sample size large dimensionality scenarios are of interest.

Qualifications, projects 1-4

Candidates should have an MSc degree in mathematics, physics, statistics, computer science, engineering, or similar, with a solid mathematical background and motivation for applying this in clinical context. Experience with image analysis techniques and good programming skills are an advantage.

Qualifications, projects 5-6

Candidates should have an MSc degree in applied mathematics, statistics, computer science, or similar, with a solid mathematical background. Experience with image analysis techniques, machine learning, and good programming skills are and advantage.

The salary and appointment terms are according to the current agreement for Ph.D. students. The appointment is for a period of 3 years and should lead to a dissertation.

Submission of applications

The application must contain

- Letter of motivation (max. 2 pages)
- Curriculum Vitae incl. list of publications

- Documentation (including marks) of completed degrees
- 2-3 page description of your proposed PhD studies
- Copies of theses or up to 3 selected publications

All interested candidates irrespective of age, gender, race, religion or ethnic background are invited to apply. The application must be submitted to madsn@diku.dk and camillaj@diku.dk and be received no later than 22 September 2008 at 12.00 noon CET.

Contact Persons

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Senior Researcher within Medical Image Analysis

Nordic Bioscience Imaging (NBI) at Nordic Bioscience A/S offers career opportunities to a senior researcher within medical image analysis. The successful candidate will be running a newly established research unit in medical image and data analysis. The position is within the field of shape and appearance modelling combined with subsequent statistical analysis for application in relation to vascular calcification.

The calcification project aims at quantifying vascular calcification and relating this to biological severity. Preliminary results on shape analysis have been published in IPMI, MICCAI, and clinical journals. PhD students are and will be associated in the project. Publications have been based on previous and ongoing clinical studies/trials including up to 6000 patients followed up to 8 years. These collections are digitised and annotated by trained radiologists.

Qualifications

The successful candidate will hold a technical PhD in (medical) image analysis and/or machine learning, and have a strong interest in bridging the gap to medical/biological research. Furthermore, the candidate will have a strong record in translating high quality scientific work into publications, will be expected to contribute to both technical and clinical publications, and will have the ambition to make the group grow.

Submission of applications

Applications including CV and list of publications must be submitted by e-mail to madsn@diku.dk and erikdam@nordicbioscience.com. We will accept applications until the end of September 2008 – but the position may be filled earlier by outstanding applicants.

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About us

Nordic Bioscience Imaging (NBI) collaborates with the Image Analysis groups at the Department of Computer Science, University of Copenhagen (DIKU); the Technical University of Denmark, the university hospitals in Copenhagen, as well as several foreign research groups.

NBI performs medical image analysis research and development with a medical focus on osteoarthritis, osteoporosis, aorta calcification and breast cancer. The main methodologies are shape modelling, pattern recognition, and development of biomarkers for clinical studies. Our research results are published in the leading technical conferences/journals (IPMI, MICCAI, IEEE TMI, MedIA) and the relevant leading clinical conferences/journals.

The director, Mads Nielsen, is also full professor at DIKU. The employees at Nordic Bioscience Imaging all have either MSc or PhD degrees in medical image analysis or related fields. NBI was founded in January 2007 and is located in Herlev with Nordic Bioscience (www.nordicbioscience.com). Nordic Bioscience is conducting world-leading research within development of biochemical biomarkers with focus on cartilage and bone diseases; as well as conducting pharmacological research and managing clinical trials.

The Image Group at the Department of Computer Science, University of Copenhagen (DIKU - www.diku.dk/forskning/image) is mainly doing research in the fields of Image Processing, Computer Vision, Robotics, Statistics, and Computer Graphics. The primary research emphasis is on the mathematical foundation of image analysis and the medical application in collaboration with clinical partners.

The Image Group currently consists of 22 researchers representing 5 nationalities. The group has been (co-)organising numerous international events such as Scale-Space 99, ECCV 2002, MICCAI 2006, SCIA 2007, and MMBIA 2007.