Postdoc proposal

Electrical impedance tomography

Keywords: Medical Imaging, Electric Impedance Tomography, Spectral methods, Scientific computing, PDEs

1. Project background

Electrical Impedance Tomography is a medical imagery technique that measures the current in response to a voltage difference applied to points on the exterior of the body. Medical imagery is essential to diagnostic medicine, and Electrical Impedance Tomography offers considerable advantages: unlike X-rays, PET scans or MRI, it does not expose the patient or personnel to potentially harmful radiation or require large high-power equipment. Additionally, it costs relatively little to operate, and it can be performed quickly using a small portable device, some of which could be transported in ambulances, making it possible to rapidly diagnose certain medical emergencies.

The reason that Electrical Impedance Tomography is not in widespread use is that the resolutions it offers are too low to be useful in medical imagery. From a mathematical point of view, reconstructing the properties of the tissue from measurements performed outside the body is called an inverse problem. Addressing this inverse problem to improve resolutions and processing time in EIT could thus allow the development of a new essential tool for medical imaging.

2. Postdoc project

In his work the postdoc is supposed to parallelize existing numerical algorithms for the problem of reconstruction of the conductivity via EIT on GPUs. The goal is to first address the two-dimensional case, and then to develop algorithms in three dimensions.

3. Candidate profile

The candidate should have a PhD in mathematics or physics. He/she has to show sufficient knowledge in some (but not necessarily all) of the following topics:

- Parallel computing on GPUs,
- Scientific computing, spectral methods,
- Programming skills in Matlab/Octave/Python/C/Cuda.

The postdoc position is for a full time research contract of 1 year.

4. Application

This research project, including the postdoc salary, will be funded by the "EITAG" project, a research grant funded by the region Bourgogne Franche-Comté, the Feder Bourgogne and the graduate school EIPHI.

For applying, send a single pdf-file **BEFORE END OF JUNE** including:

- Curriculum Vitae
- Short summary of the PhD thesis
- Suggestion of two referees with contact details
- Detailed explanation justifying your choice for this postdoc project to:

Christian Klein: Christian.Klein@ubfc.fr

(webpage: https://math.u-bourgogne.fr/IMB/klein/Welcome.html)

5. References

1. [1] D. Isaacson, J.L. Mueller, J.C. Newell and S. Siltanen, Reconstructing of chest phan- toms by the D-bar method for EIT IEEE Trans. on Med. imaging 23 No.7 (2004)
2. [2] S. J. Hamilton, C. N. L. Herrera, J. L. Mueller, and A. Von Herrmann. A direct D-bar reconstruction algorithm for recovering a complex conductivity in 2-D Inverse Problems 25, 095005 (2012).
3. [3] C. Klein, N. M. Stoilov, Numerical scattering for the defocusing Davey-Stewartson II equation for initial data with compact support, Nonlinearity 32 4258, (2019)
4. [4] C. Klein, K. Maclaughlin and N. M. Stoilov, Spectral approach to the scattering map for the semi-classical defocussing Davey-Stewartson II equation, Physica D: Nonlinear Phenomena (2019)