

**JOB DESCRIPTION**

Job Title: New filtering strategies to enhance Magnetic Resonance Sounding applications.

**Job Summary :**

Performing Nuclear Magnetic Resonance of the protons in the geomagnetic Earth field (called SNMR or MRS) allows detecting liquid water content in the ground, and characterizing the geological materials through decay times linked to pores sizes and magnetic heterogeneities. It makes it a powerful tool for hydrogeological purposes and in-situ investigation of the shallow subsurface down to almost 100m.

After 30 years of development, the technology is mature and applications can be found in many natural environments: from sedimentary aquifer to weathered bedrock, coastal aquifer to permafrost and glacier...

Today's main limitation for a broader use of the technics is clearly the weak signal to noise ratio (SNR). Despite many improvements and strategies, it is often difficult to perform SNMR in peri-urban context, or in low porosity rocks – where hydrogeophysics is the more needed.

The candidate, with skills in signal processing, inversion, electromagnetism (EM), will propose, implement and test in-situ EM noise removal approaches at the field scale, mainly in France.

**Job Description :**

The candidate will join a team specialized in shallow geophysics and processes modeling, namely the experimental geophysics group, leaded by Dr. R. Toussaint at Institut de Physique du Globe de Strasbourg (IPGS). The post-doctoral work will be supervised by Prof. J-F Girard who recently joined the research group.

The research group has long experience in modeling and measuring weak and unstable signals such as encountered in magnetotelluric, spontaneous potential and electrokinetics.

In SNMR, the instantaneous SNR is commonly  $< 1/100$  to  $1/10.000$  and heavy processing both in the time domain and frequency domain with high number of stacks is often necessary. Basic filtering schemes using the narrow frequency band content of the (generally) exponentially decaying sinusoidal NMR signal are not always applicable when the disturbing frequencies are too close to the signal frequency (called Larmor Frequency) and unstable. In addition, such heavy filtering may generate artefacts which reduces the quality of the signal, and hence, the usefulness of the method. Multi-channel strategies to build subtracting filter from remote receivers, statistical approach to parameterize the noise structure, optimize design of the arrays, etc... are some of the recently developed approaches. The candidate will have access to a state of the art in-house software including the most recent algorithms, and a long lasting database of signals. A lack of experience in SNMR or in experimental geophysics is not crippling, especially the candidate will closely work with an experienced specialist of SNMR use.

Institute of Physics du Globe of Strasbourg is participating to the national research program named Critex and will have access to a recent pool of geophysical equipment and measurement facilities on field sites, especially in Alsace (Strasbourg area).

The duration of the post-doctoral position is 18 months maximum, and should end not later than the 31/12/2017.

The candidate should have obtained a PhD degree not before the 01/01/2012 (less than 4 years) & not in Strasbourg.

Salary is indexed on the 3<sup>rd</sup> step of Associate Professor, ~ 2637 € / month (before charges & taxes).

Some references:

<https://eost.unistra.fr/fileadmin/upload/EOST/Actus-Agenda/NL2.CRITEX.pdf>

<http://eost.unistra.fr/en/recherche/ipgs/>

Dalgaard, E., Auken, E., Larsen, J., 2012. Adaptive noise cancelling of multichannel magnetic resonance sounding signals. *Geophys. J. Int.* 191 (1), 88–100.

Girard J-F., Legchenko A. and Boucher M., 2005. Stability of MRS signal and estimating data quality, *Near Surface Geophysics*, 2005, vol. 3, p. 187-194.

Girard J-F., S. Penz, A. Texier, JM. Baltassat, A. Legchenko, 2015, Noise removal in MRS applications: field cases and filtering strategies, 6th International Workshop on Magnetic Resonance, 8-10 June, Aarhus, Denmark

Legchenko A., C. Vincent, J. M. Baltassat, J.F. Girard, E. Thibert, O. Gagliardini, M. Descloitres, A. Gilbert, S. Garambois, A. Chevalier, H. Guyard, 2014, Monitoring water accumulation in a glacier using magnetic resonance imaging, *The Cryosphere*, 01/2014; 8:155–166.

Muller-Petke, M., Costabel, S., 2014. Comparison and optimal parameter setting of reference-based harmonic noise cancellation in time and frequency domain for surface-NMR. *Near Surf. Geophys.* 12 (2), 199–210

Walsh, D.O., 2008. Multi-channel surface NMR instrumentation and soft-ware for 1D/2D groundwater investigations. *J. Appl. Geophys.* 66, 140–150.

Main research field :

Engineering / Geosciences / Geophysics/ Hydrogeophysics / Mathematics / Physics / Technology

#### JOB DETAIL

Type of contract : Temporary
Status : Full-time
Company / Institute : Institut de Physique du Globe de Strasbourg, Université de Strasbourg
Country : France
City : Strasbourg
Postal Code : 67000
Street : 4 rue Blaise Pascal

#### APPLICATION DETAILS (mandatory)

Envisaged job starting date : asap – envisaged 01/06/2016
Application deadline : 30/04/2016 (may be extended)
Application e-mail : <a href="mailto:jf.girard@unistra.fr">jf.girard@unistra.fr</a>