Research Engineer Post Opening: Physical modeling of the geometry of the Corona Spy Satellites. Application to Earth Sciences ».

1-Contexte and objective

Following the development of modern optical satellite sensors and of the image matching algortihms (Leprince et al., 2007; Rosu et al., 2015), the calculation of deformations from images has become a common tool to quantify the movements of the Earth litosphere after a disaster (e.g., tectonic activity, landslides). Witin the framework of the Tosca funding, the three research institutes: IPGP, IGN and CNES, have been collaborating for the last 6 years on the use of photogrammetry in Earth Sciences. As a part of this collaboration, the processing chain of MicMac the free open-source software for photogrammetry was adapted to take into account the geometries of the modern optical satellites. As of now, MicMac can calculate the digital surface model (DSM) and 2D deformation maps using practically any high resolution satellite, enabling the analyses of deformation processes of the Earth litosphere.

To understand such processes over longer periods, going back to the pre-modern satellite era, analoque imagery seems to be a precious source of information. The CORONA is a constellation of satellites launched by the USA during the cold war. Their employement provided regular acquisitions between 1959 and 1972. Since 1995 they are declassified, are undergoing the process of digitization and most importantly are available free of charge.

Within the TOSCA project, the objective of the partners is to be able to calculate deformations between the Corona images, and images acquired recently.

2- Work programme

The use of CORONA in photogrammetry is challenging on the one hand due to the specific geometry of the sensor, and on the other hand due to the lack of information on satellite's geolocalisation. The planned work will be divided into three main parts:

- establishing of the mathematical model of the Corona sensor using the existing documentation;
- implementation of adequate methods for calculting the initial values of the mathematical model using only tie-points as observations (i.e. per single image calculation);
- implementation of the new model in MicMac in order to use the existing approaches for bundle adjustement;

3-Candidat's profil

The candidate should characterise by :

- skills and strong interest in programming in C/C++;
- skills and interest in applied maths and ideally some knowledge of photogrammetry.

4-Workplace et contact

The work will take place at IGN Saint-Mandé and Institute de Physique du Globe, Paris. Contacts:

- marc.pierrot-deseilligny@ensg.eu - 33 (0) 1 43 98 80 61 ;
- klinger@ipgp.fr - 33 (0)1 83 95 76 23 ;
- delorme@ipgp.fr ; 33 (0)1 83 95 76 13
- ewelina.rupnik@ensg.eu 33 (0)1 43 98 00 00 p 7566 .

5-Conditions

- CDD in a public institution, renewable for a year
- salary dependent on the candidat's experience (CNRS salary grid)

References:

Leprince, S., Ayoub, F., Klinger, Y. and Avouac, J.P., 2007, July. Co-registration of optically sensed images and correlation (COSI-Corr): An operational methodology for ground deformation measurements. In *Geoscience and Remote Sensing Symposium, 2007. IGARSS 2007. IEEE International* (pp. 1943-1946). IEEE.

Rosu, A.M., Pierrot-Deseilligny, M., Delorme, A., Binet, R. and Klinger, Y., 2015. Measurement of ground displacement from optical satellite image correlation using the free open-source software MicMac. *ISPRS Journal of Photogrammetry and Remote Sensing*, *100*, pp.48-59. Pierrot-Deseilligny, M