PhD Proposal 2017

School: Ecole Centrale de Nantes	
Laboratory: GeM	**Web site:** http://gem.ec-nantes.fr/
Team: Matériaux - Environnement – Ouvrages (MEO)	**Head of the team: Prof. A. Loukili**
Supervisor: Prof P. Kotronis **Prof G. Sciarra**	**Email:** Panagiotis.Kotronis@ec-nantes.fr Giulio.Sciarra@ec-nantes.fr
Collaboration with other partner during this PhD: **In France:**	**In China:**

Title: Bearing capacity of suction bucket foundation: from multi-scale modeling to macro-element
Scientific field: Civil Engineering, Geotechnics
Key words: Soils, foundations, constitutive modeling, finite element analysis, multiphysics, coupled phenomena, hydro-mechanical calculations

Details for the subject:

Background, Context:

A suction bucket is a closed-top steel tube, which is first lowered to the seafloor allowing bottom sediments to penetrate under its own weight, and then pushed to full depth with suction force produced by pumping water out of its interior. The main advantages of suction buckets are the convenient method of installation, their repeatedly use and the fact that they may mobilize a significant amount of passive suction during uplift. Recently, suction buckets have been widely used for different types of constructions such as gravity platform jackets, jack-ups, offshore wind turbines, subsea systems and seabed protection structures. For an optimal bucket structural design, a good understanding of the performance of the bucket foundation is necessary.

The purpose of the PhD study is to estimate the bearing capacity of a suction bucket foundation under different loading conditions (combined vertical, horizontal loads and moments; monotonic static, cyclic and seismic (dynamic) loadings) and to provide simplified non-linear numerical tools for engineering design offices. Multi-scale modeling will be used for the soil (from particle or grain level to the meso structure and to the representative volumetric element, see Yin et al. 2010). Typical centrifuge tests and in-situ measurements will be reproduced numerically and then a macro-element will be developed and implemented in existing finite element codes (Li et al. 2014, 2016).

References:

1. Li Z., Kotronis P., Escoffier S., Tamagnini C. 'A hypoplastic macroelement for single vertical piles in sand subject to three-dimensional loading conditions'. *Acta Geotechnica*, 11(2), 373-390, 2016.
2. Li Z., Kotronis P., Escoffier S. 'Numerical study of the 3D failure envelope of a single Pile in sand'. *Computers and Geotechnics,* October, volume 62, pages 11–26, 2014
3. Yin Z.-Y., Chang C.S., Hicher P.Y. 'Micromechanical modelling for effect of inherent anisotropy on cyclic behaviour of sand'. *International Journal of Solids and Structures*, vol. 47 n° 14-15, pp 1933-1951, 2010.