

Dynamic soil-structure interaction for wind turbine towers

CentraleSupélec



NICOLAS BAUDIN
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	CentraleSupélec
Name of the host laboratory / research team	MSSMat
Address	3, rue Joliot Curie 91190 Gif-sur-Yvette France
Web site	http://mssmat.centralesupelec.fr/
Name of the supervisor	Pierre Jehel
Function	Assistant Professor
Email	pierre.jehel@centralesupelec.fr

Internship offer

Topic of the internship (title) Dynamic soil-structure interaction for wind turbine towers

Proposed dates of the internship* **Start:** 2020-10-01 **End:** 2021-03-31

* The supervisors have indicated the dates proposed are flexible and are able to be postponed subject to COVID-19 border closures.

Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

Description of the internship:

Dynamic loading needs to be considered when designing wind turbines. On the one hand, the rotational speed of the rotor, the passing blades, and the wind gusts induced all generate dynamic loads on the wind turbine tower with dominant frequencies usually below 1 Hz¹. On the other hand, wind turbine tower is anchored in the ground and the dynamic loading is transmitted to the soil. To accurately simulate the structural behavior of wind turbines, the dynamic response of the soil surrounding the foundation needs to be accounted for and soil-structure interaction should be considered. Besides, soil properties may vary with respect to the loading frequency². The objective of this internship is twofold:

- 1) The experimental investigation of the sensitivity of the response of a given soil (to be determined) to the frequency of the dynamic loading. This can be done performing cyclic triaxial tests.
- 2) Developing the numerical model of a coupled system {wind turbine + soil} that accounts for the soil response dependence on the frequency content of the loading.

Other objectives:

- Developing the collaboration between Sémofi and CentraleSupélec;
- Open position for a Geotechnical Engineer at Sémofi after the internship.

Supervision:

- Dr. Kastriot Çami (Sémofi), kastriot.cami@semofi.fr, Dr. Pierre Jehel (MSSMat), pierre.jehel@centralesupelec.fr

Place of internship:

The intern will work both at Sémofi and MSSMat laboratory: Entreprise Sémofi, Villeneuve-le-Roi (94) - Laboratoire MSSMat UMR CNRS 8579, CentraleSupélec / Université Paris-Saclay

References [1] S. Adhikari and S. Bhattacharya, Dynamic analysis of wind turbine towers on flexible foundations. Shock and Vibration 19 (2012), 37-56. [2] J.-F. Serratrice, Comparison of cyclic triaxial strength of soils tested in their natural state, 9ème colloque AFPS (2015), Marne-la-Vallée, France.

Name of industrial partner	SEMOfI
Role of the industrial partner in the internship project	Co-design of the internship project; Hosting of the intern for short periods; Supplier of experimental facilities for soil testing; Supplier of data; Financial support for carrying out the project.
Main contact at the French industrial partner	Kastriot CAMI
Email of contact at French industrial partner	kastriot.cami@semofi.fr

Expected profile of applicant

Level of study	Bachelor's or Master's students
Discipline	Civil Engineering; Geotechnical Engineering; Structural Dynamics; Soil Dynamics
Required qualities, knowledge and skills	Background in one or more of the disciplines mentioned above. Interest for research work; Autonomy; Rigor. Skills in: Matlab or Python, Excel.

Research Internship – Bachelor or Master level

Dynamic soil-structure interaction for wind turbine towers



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Dynamic loading needs to be considered when designing wind turbines. On the one hand, the rotational speed of the rotor, the passing blades, and the wind gusts induced all generate dynamic loads on the wind turbine tower with dominant frequencies usually below 1 Hz [1]. On the other hand, wind turbine tower is anchored in the ground and the dynamic loading is transmitted to the soil.

To accurately simulate the structural behavior of wind turbines, the dynamic response of the soil surrounding the foundation needs to be accounted for and soil-structure interaction should be considered. Besides, soil properties may vary with respect to the loading frequency [2].

The objective of this internship is twofold:

- 1) The experimental investigation of the sensitivity of the response of a given soil (to be determined) to the frequency of the dynamic loading. This will be done performing cyclic triaxial tests (see Annex below).
- 2) Developing the numerical model of a coupled system {wind turbine + soil} that accounts for the soil response dependence on the frequency content of the loading.

Other objectives:

- Developing the collaboration between Sémofi and CentraleSupélec;
- Open position for a Geotechnical Engineer at Sémofi after the intership.

Supervision:

- Dr. Kastriot Çami (Sémofi), kastriot.cami@semofi.fr
- Dr. Pierre Jehel (MSSMat), pierre.jehel@centralesupelec.fr

Place of internship :

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- Laboratoire MSSMat UMR CNRS 8579, CentraleSupélec / Université Paris-Saclay

References

- [1] S. Adhikari and S. Bhattacharya, Dynamic analysis of wind turbine towers on flexible foundations. *Shock and Vibration* **19** (2012), 37-56.
- [2] J.-F. Serratrice, Comparison of cyclic triaxial strength of soils tested in their natural state, 9ème colloque AFPS (2015), Marne-la-Vallée, France.

Annex:

Soil	Effective confinement	Loading type	Loading frequency (Hz)				
			0,05	0,25	0,5	1	5
	100 kPa	Sine					



Triaxial cyclic test machine (Sémofi)