

**RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM**  
*(one page maximum)*

**Field:** Materials Science, Mechanics, Fluids

**Subfield:** (Applied Mechanics)

**Title:** A systematic approach for cracked rotating shaft analysis

**ParisTech School:** Arts et Métiers Sciences et Technologies

**Advisors Names:** Saber EL AREM, Amine Ammar

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**Research group/Lab:** LAMPA

**Lab location:** Angers, France

**(Lab/Advisor website):** <http://lampa.ensam.eu/>

**Short description of possible research topics for a PhD:**

For rotating shafts, a propagating fatigue crack can have detrimental effects on the reliability of a process or utility plant where these vital parts are subjected to very arduous working conditions in harsh environment. The vibration analysis and modeling of the shaft and cracks are necessary for a reliable identification of the crack location and depth to avoid catastrophic failures. In fact, cracks can develop and propagate to relevant depths without affecting consistently the normal operating conditions of the shaft. We recently have presented a systematic approach in dealing with the problem of modeling cracked rotating shafts. The breathing mechanism identification is the crucial step in the process and has been made with the greatest care. The approach presented is original and its implementation in industrial context is straight forward. The objective, based on previous development we have recently proposed, is to build a finite element of cracked rotor to be use to explore the problem of multiple cracks affecting the same shaft and to suggest an analysis methodology.

**Required background of the student:** Mechanics, Physics, Applied mathematics.

**A list of 5 (max.) representative publications of the group:**

1. S. El Arem. On the mechanics of beams and shafts with cracks : A standard and generic approach. Eur Jou Mechanics-A/Solids 85,104088, 2020

2. S. El Arem. Nonlinear analysis, instability and routes to chaos of a cracked rotating shaft. *Nonlinear Dynamics* , 96(1) :667-683, 2019
3. S. El Arem and M. Ben Zid. On a systematic approach for cracked rotating shaft study : breathing mechanism, dynamics and instability. *Nonlinear Dynamics* , 88(3) :2123-2138, 2017
4. S. El Arem and Q.S. Nguyen. Nonlinear dynamics of a rotating shaft with a breathing crack. *Annals of Solid and Structural Mechanics* , 3(1-2) :1-14, 2012
5. S. El Arem and H. Maitournam. A cracked beam finite element for rotating shaft dynamics and stability analysis. *J. of Mechanics of Materials and Structures* , 3(5) :893-910, 2008

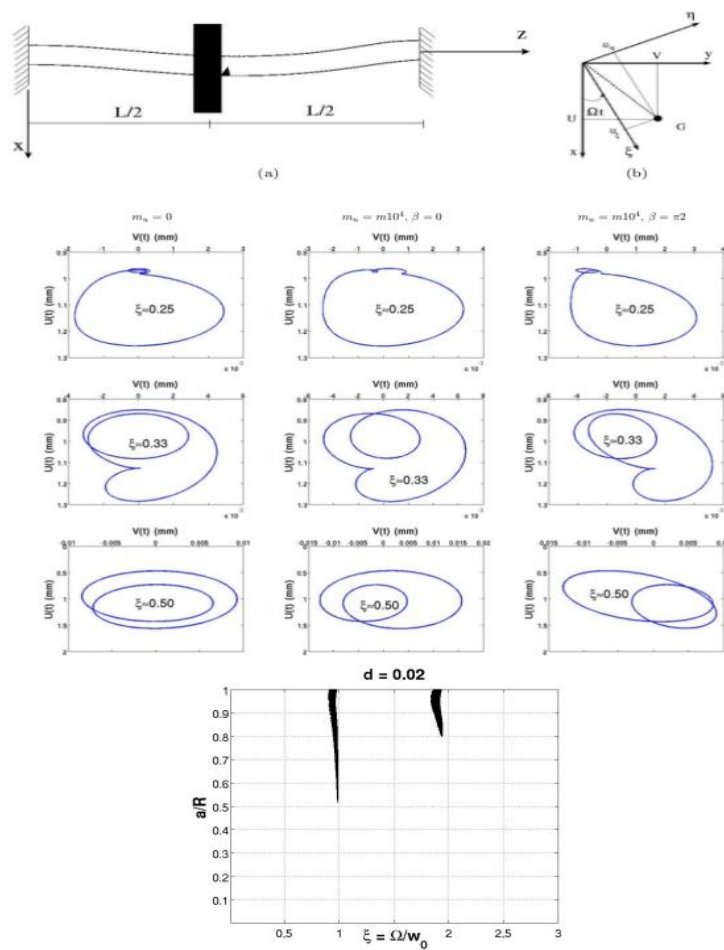


Figure: System, Orbits, stability