15th INTERNATIONAL CONFERENCE
Dynamical Systems — Theory and Applications
December 2-5, 2019. Lodz, POLAND.

DSTA 2019

paper id: LIF189

Bending vibration systems as tactile sensors for contact point detection using natural frequencies

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Abstract: In recent years, bending beam vibrations are analyzed in context to develop biologically inspired sensor systems. Here, this paper contributes to this field and we extend results from conservative systems to dissipative ones herein. We use mechanical models – inspired by the vibrissae of rats and mice – to determine the distance to an object (contact detection) and to get hints for a technical implementation. In contrast to literature, we extend our models to more realistic ones in incorporating fundamental features of a vibrissae: the viscoelasticity of the Follicle-Sinus complex (FSC, support of the vibrissa) and of the skin. Moreover, the conical shape is taken into account, as well, to study the impact of these features on the dynamics. Due to the complexity of previous models, we model the FSC as a viscoelastic-foundation, the skin as a discrete spring-damper-combination, and the conical shape using a three segmented rod with different diameters. The contact point is firstly modeled as a (fixed) bearing. To determine the distance out of the eigenvalues / natural frequencies (later measured in experiments), we develop an algorithm that is tested to be valid for our models.

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