Ecole doctorale SMAER
Sciences **M**écaniques, **A**coustique, **E**lectronique, **R**obotique

Thesis subject 2021

Laboratory : ISIR Institut des Systèmes Intelligents et de Robotique

University: Sorbonne Université – CNRS UMR7222

Title of the thesis: Design and control of a flexible manipulator for fruit picking

Thesis supervisor: Faïz Ben-Amar

Email contact: amar@isir.upmc.fr

Number of phd student: 4 with 3 co-supervised

Co supervisor : Jérôme Szewzyck

Collaborations within the thesis: Muséum National d'Histoire Naturelle

This subject can be published on the doctoral school's web site: Yes

Thesis's summary (abstract):

The goal of the thesis is to develop a flexible manipulator like a trunk for grasping of a fragile object such as a fruit. This robotic object would address three research issues, design, modeling and control, and finally machine learning, which are in an ideal world, should be addressed in a joint and integrated approach, called sometimes "hardware-software co-design". The design will be based a priori on a deformable continuum structure without articulation and with a cable transmission. We will study particularly the routing of the cables, such as the helical and/or internal routings and their influences especially on the working space of the manipulator and pose repeatability. The modeling and control will seek to find a good tradeoff between model fidelity and computing time efficiency. For this purpose, the use of a reduced model of a deformable body (Cosserat beam model or reduced model from FEM), combined with model predictive control MPC, is a relevant solution capable of taking into account the under-actuation, kinematic redundancy and physical constraints such as actuator limitations. Finally, learning from real and/or simulated data is a interesting way that we will also explore because it is more robust for systems that are difficult to model and that present a large number of variables, such as a redundant deformable object in multiple interaction with object having different geometry and stiffness.

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For the developed version, please see the French version or contact supervisors.