Optimal Placement of Mechatronic System

**Promoter:** Christophe Collette  **Co-promoter:** Arnaud Deraemaeker
**Supervisor:** Dimitri Piron – dimitri.piron@ulb.be

**Context:** Vibration control architectures are of high interest in the field of large and lightweight structures that require high performance. Such structures are indeed extremely sensitive to structural vibrations and require therefore an alleviation strategy to avoid, for example, operational error as illustrated by Figure 1.

Although a proper design of the control law that successfully meets robustness and performance is critical for the vibration alleviation, the appropriate position of the transducers on the system is also a well-established concern. Unfortunately, a real trade-off currently exists between the obtained control performance and the computational time required for its design. Because such high computational time can be problematic for industrial projects, a new placement criterion has recently been developed which allows high closed-loop performance and a reduced computational time. This new placement criterion is based on the distance between the resonance frequencies (poles of the system) and the related transmission zeros, as illustrated by Figure 2. This new criterion is promising because it can be computed in open-loop (i.e. small computational cost) while predicting the closed-loop performance. The full description of this new criterion can be found in [2].

**Goal:** This project aims to extend the new pole-zero distance criterion to piezoelectric transducers. Because a state of the art has already been performed, the student will be able to quickly start on the finite element simulations. **According to the student profile, the emphasis can be put on various aspects** and could open various applications.

**Tasks** (to be discussed depending of the student profile):

- Apply the current criterion on a structure with piezoelectric patches and compare to literature
- Improve the optimization criterion
- Analyse the impact of the size, the shape... on the obtained solution
- Experimental validation of the obtained solution

This project is a good opportunity to develop **advanced skills that are valued by companies**, such as structural dynamics, vibration damping strategies, optimization and extraction of state space systems from finite element software.

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[1] (ESO) European Southern Observatory, [https://www.eso.org/public/](https://www.eso.org/public/)