Stiffness Control of a Joint with Combined VSA and Constant Stiffness Actuation

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Level: Bachelor/Master (1-2 students possible)
Duration: 3 months
Start: By agreement
Mentors: Branko Lukić
Institution: ETF Robotics

Overview and Technology: This aim of the project is to develop mathematical and simulation model of Variable stiffness actuator (VSA) simultaneously actuated with one VSA and one actuator of constant stiffness in MATLAB/Simulink environment. For developed model, appropriate control algorithm for VSA should be identified and implemented. The goal is to make the joint in steady state behave like spring, so that the joint can interact safely with the environment, while tracking position trajectories. Instead of commanding only position, the controller shapes the static relationship between **pose error** and **interaction forces**. The work includes modeling, controller design and simulation results where achieving desired joint stiffness is demonstrated.

Platforms / hardware	**Software & tools**
• PC Workstation	• MATLAB/Simulink

Project options (Initial project requirements can be modified to include additional tasks based on student interests**)**

- **Initial project requirement:** Developing of mathematical and simulation model of actuator consist of VSA+SEA
- Modification of existing control algorithm for VSA
- Custom control algorithms.
- Stability analysis of control algorithm.

Expected outcomes	**Recommended background**
• Literature review • Project code and documentation/simulation • Final report in IEEE research paper form	• Basics of MATLAB/Simulink programming • Basics on Control

Initial Literature

- Cascade Control of Antagonistic VSA—An Engineering Control Approach to a Bioinspired Robot Actuator (https://www.frontiersin.org/journals/neurorobotics/articles/10.3389/fnbot.2019.00069/full)
  FEEDBACK LINEARIZATION FOR DECOUPLED POSITION/STIFFNESS CONTROL OF BIDIRECTIONAL ANTAGONISTIC DRIVES (https://casopisi.junis.ni.ac.rs/index.php/FUElectEnerg/article/viewFile/2314/1899)