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Parameter Identification of Flexible Link Manipulaors Using Evolutionary Algorithms

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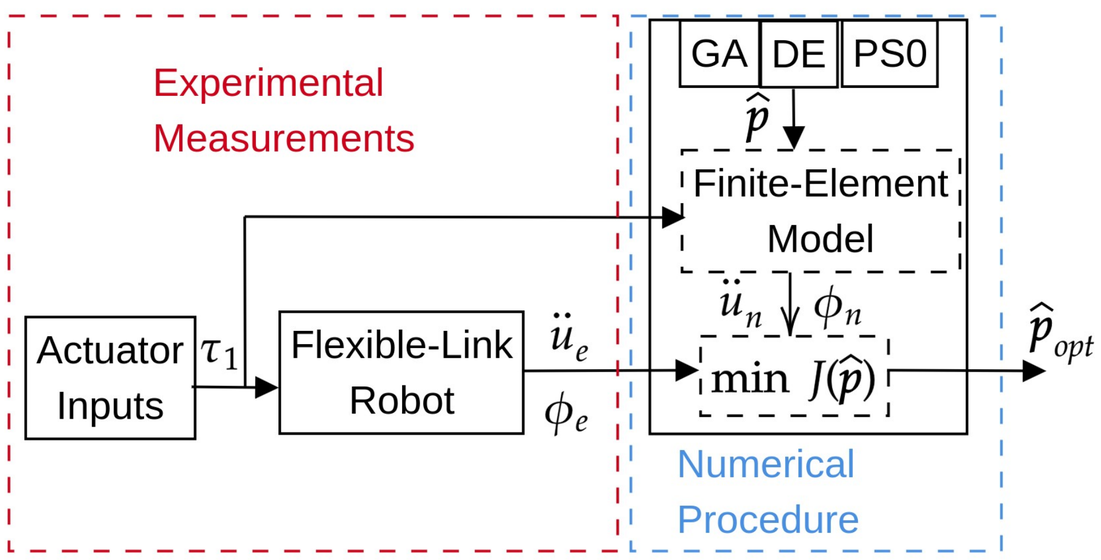
INTRODUCTION & AIM

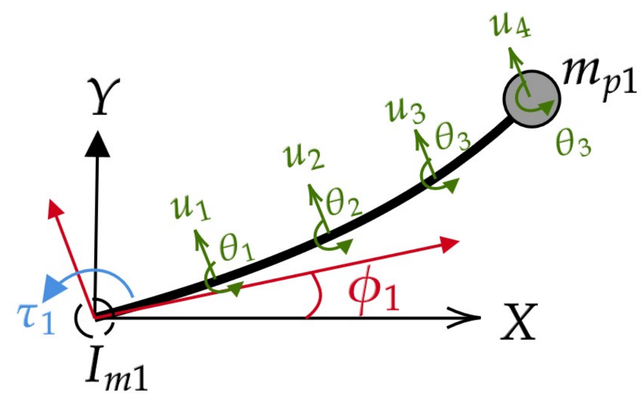
This paper addresses the parameter identification of a one-link flexible manipulator based on the experimental measurement of the inputs/outputs, the finite element model, and the application of evolutionary algorithms:

- The dynamic model is initially obtained using the finite element method and the Lagrange principle.
- A prototype of a single one-link flexible manipulator is used in the experimental application.
- An optimization problem minimizes the difference between numerical and experimental outputs to determine the set of parameters using evolutionary algorithms.
- A comparative analysis to obtain the identified parameters is established using genetic algorithms, particle swarm optimization, and differential evolution.

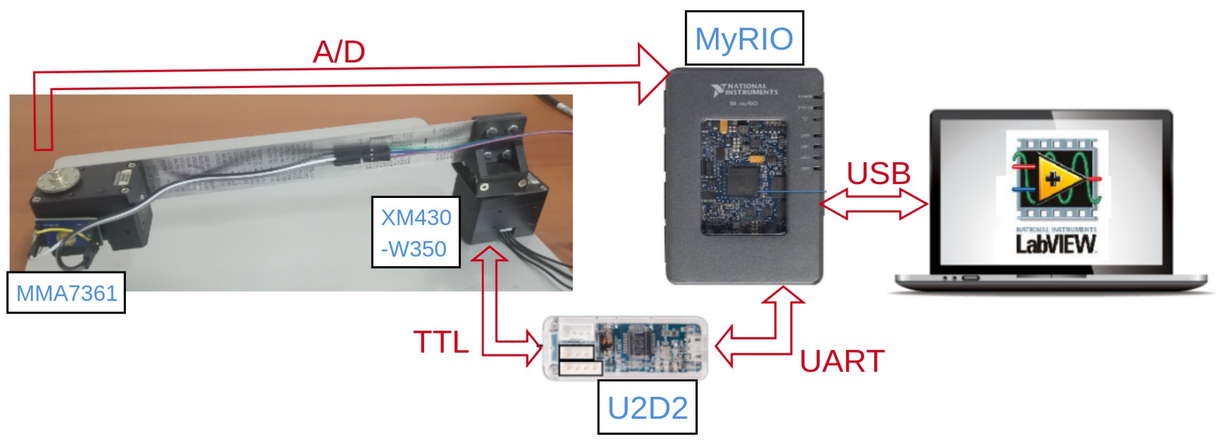
METHOD



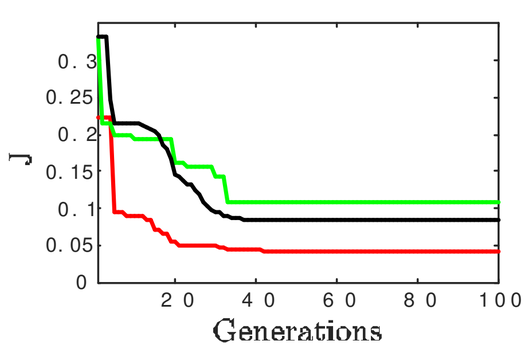
$$J(\hat{\mathbf{p}}) = \frac{\|FRF_e - FRF_n(\hat{\mathbf{p}})\|}{\|FRF_e\|} + \frac{\|\phi_e - \phi_n(\hat{\mathbf{p}})\|}{\|\phi_e\|}$$

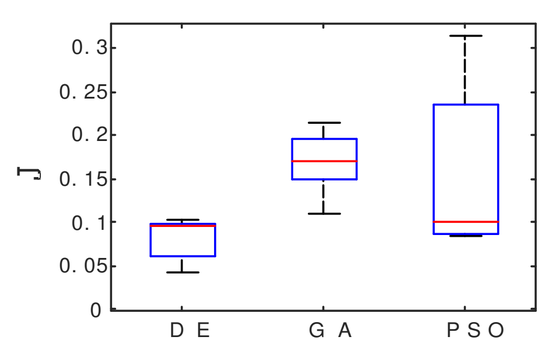


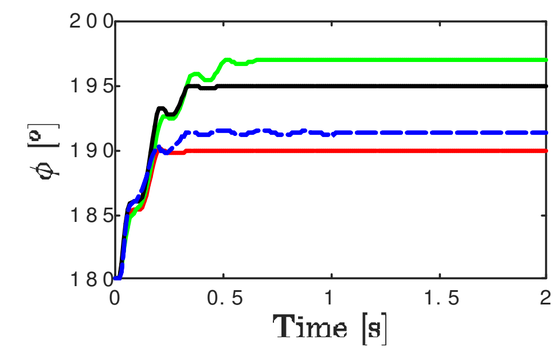
$$\mathbf{M}_1(\mathbf{q}_1)\ddot{\mathbf{q}}_1 + \mathbf{h}_1(\mathbf{q}_1, \dot{\mathbf{q}}_1) + \mathbf{C}_1\dot{\mathbf{q}}_1 + \mathbf{K}_1\mathbf{q}_1 + \mathbf{f}_b = \mathbf{f}_1$$

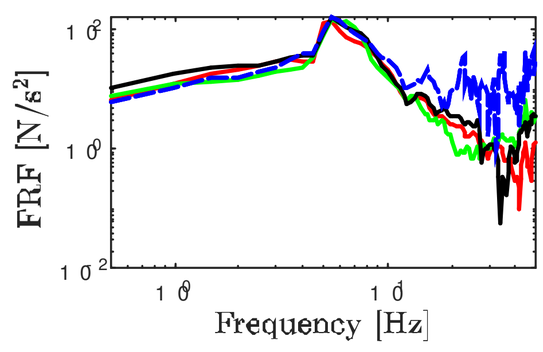


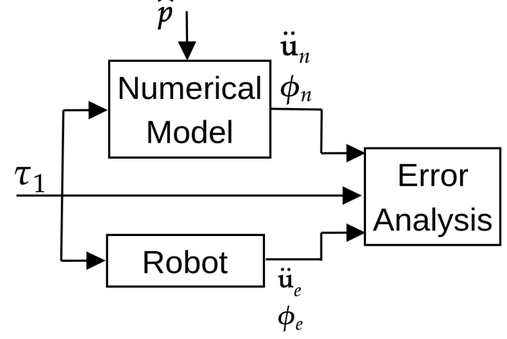
RESULTS & DISCUSSION

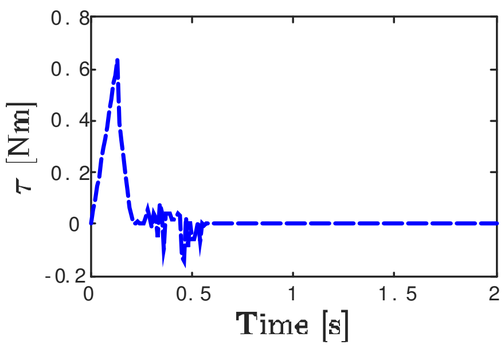


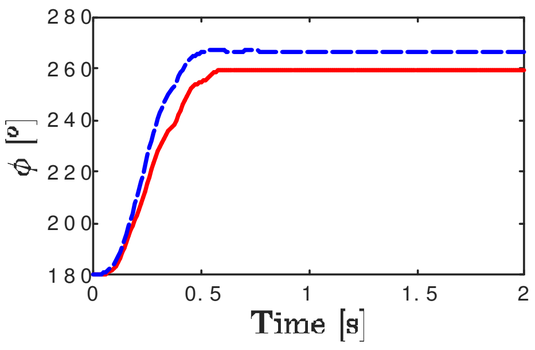


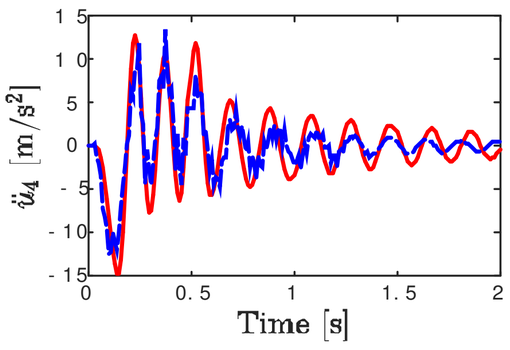


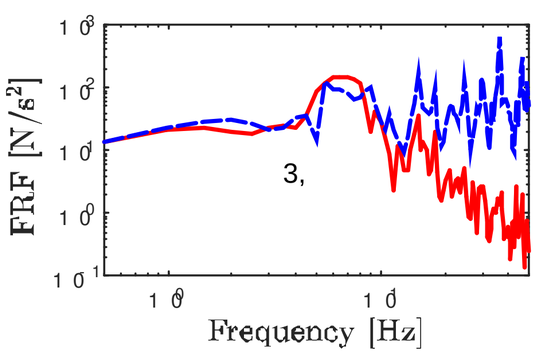












CONCLUSION

The proposed methodology permitted to estimate the joint friction, stiffness and damping coefficients of the flexible-link that can not be determined by experimental measurements. Additionally, The the numerical model with the identified parameters simulates adequately the dynamics regarding the joint response and the vibrational flexible-link dynamics of the manipulator as demonstrated in the model validation approach.

FUTURE WORK / REFERENCES

Further research work will aims at the development of control schemes of flexible-link manipulators based on the identified model.