

Model-Predictive Control for Dielectric Elastomer Wave Harvesters in Presence of Waves from Brownian Motion Noise.

Matthias K. Hoffmann* Lennart Heib* Giacomo Moretti**
Gianluca Rizzello*** Kathrin Flaßkamp*

* *Systems Modeling and Simulation,*
(e-mail: {matthias.hoffmann, kathrin.flaskkamp}@uni-saarland.de,
lennartheib@gmail.com)

** *Università degli Studi di Trento, (e-mail: giacomo.moretti@unitn.it)*

*** *Intelligent Material Systems Lab,*
(e-mail: gianluca.rizzello@imsl.uni-saarland.de)

* and *** from Saarland University, Saarbrücken, Germany.

Abstract: Full contributions for the 10th Vienna Conference on Mathematical Modelling are limited to 6 pages. Please keep the abstract of your paper within a limit of approximately 300 words.

Keywords: Optimal Control, Model-predictive Control, Energy Harvesting, Non-Linear Optimization, Dielectric Elastomer Generators

1. INTRODUCTION

4.3 Model-predictive Control

2. MODEL AND PROBLEM STATEMENT

5. CONCLUSION

3. METHODS

REFERENCES

3.1 Model-predictive Control

Model-predictive Control (MPC) arose from optimal control as one answer on how to “close the loop” (Rawlings et al. (2017)). In optimal control, a system’s behaviour is predicted into the future, while optimising the inputs to the system, such that a cost function is minimised. The working principle of MPC is repeatedly solving an Optimal Control Problem (OCP), only applying the first of the calculated inputs, and measuring the system’s state.

3.2 Fractional Brownian Motion Noise

4. NUMERICAL RESULTS

The following simulations were done using MATLAB. The optimisation problems were formulated using the CasADi package by Andersson et al. (2019) and the Ipopt solver by Wächter and Biegler (2006).

4.1 Fractional Brownian Motion Noise

4.2 Multi-objective Optimal Control

Methods from Hoffmann et al. (2022).

Andersson, J.A., Gillis, J., Horn, G., Rawlings, J.B., and Diehl, M. (2019). Casadi: a software framework for nonlinear optimization and optimal control. *Mathematical Programming Computation*, 11(1), 1–36. doi: 10.1007/s12532-018-0139-4.

Hoffmann, M.K., Moretti, G., Rizzello, G., and Flaßkamp, K. (2022). Multi-objective optimal control for energy extraction and lifetime maximisation in dielectric elastomer wave energy converters. In *10th Vienna International Conference on Mathematical Modelling*, (accepted).

Rawlings, J.B., Mayne, D.Q., and Diehl, M. (2017). *Model predictive control: theory, computation, and design*, volume 2. Nob Hill Publishing Madison, WI.

Wächter, A. and Biegler, L.T. (2006). On the implementation of an interior-point filter line-search algorithm for large-scale nonlinear programming. *Mathematical programming*, 106(1), 25–57.