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Efficient data-driven control of fluids using autonomous surrogate models

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As in almost every other branch of science, the advances in data science and machine learning have also resulted in improved modeling and simulation of fluid flow systems. In many cases, predictive methods are advertised to ultimately be useful for control. However, the question of how to use a predictive model for control is left unanswered in many cases due to the associated challenges, namely a significantly higher system complexity, the requirement of much larger data sets and an increased and often problem-specific modeling effort. To solve these issues, we present a universal framework to transform arbitrary autonomous models into control systems and use them for feedback control, using quantization and relaxation. The advantages are a linear increase in data requirements with respect to the control dimension, performance guarantees that rely exclusively on the accuracy of the predictive model, and only little prior knowledge requirements in control theory to solve complex control problems.

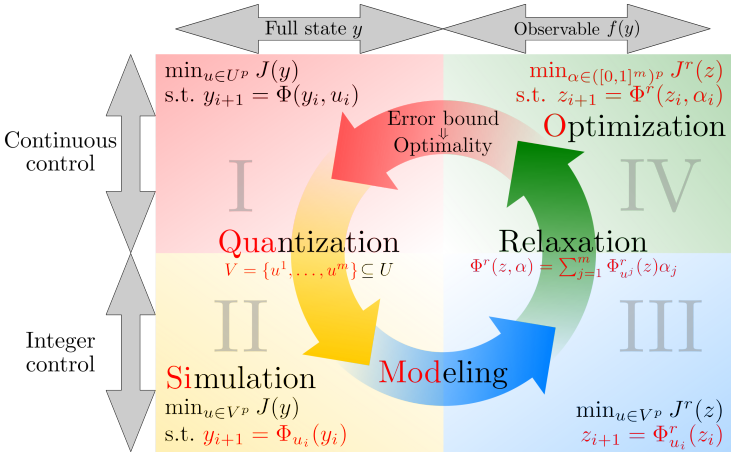

Figure 1: The QuaSiModO framework consisting of the four steps Quantization, Simulation, Modeling and Optimization [1].

REFERENCES

[1] S. Peitz and K. Bieker. On the Universal Transformation of Data-Driven Models to Control Systems. *arXiv:2021.04722*, 2021.