Data-driven optimal tuning of BLDC motors with safety constraints: a Set Membership approach

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***Abstract*—*Field Oriented Control* (FOC) is among the most popular control architectures for *brushless dc* (BLDC) motors, employed in several mechatronic applications. Data-driven strategies allow for model-free, optimal tuning of FOC parameters, optimizing a quantitative performance index. While fast, non-iterative data-driven techniques like *Virtual Reference Feedback Tuning* (VRFT) are sensitive to the choice of the training experiment and the desired closed-loop behavior. On the other hand, iterative data-driven techniques represent a more robust approach, with less critical experiment design and the ability to account for the presence of nonlinearities. However, commonly-used iterative algorithms like Bayesian Optimization (BO) are often computationally expensive, and require *caution* in the selection of the parameters to avoid instabilities in closed-loop experiments. The contribution of this work is to formulate the tuning problem of FOC parameters as a *model reference* optimization problem suitable to be solved with *Set Membership Global Optimization*-Δ. This novel, iterative algorithm, allows one for the specification of safety constraints and is computationally more efficient than BO. An extensive experimental analysis on a real setup confirms the effectiveness of the proposed approach, and shows that a safe warm-start based on VRFT yields faster convergence to the optimal parameters.**

***Index Terms*—Auto-tuning, Machine Learning, BLDC.**

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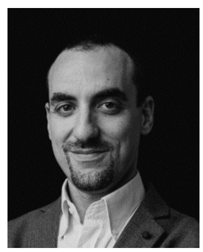

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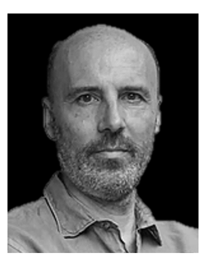

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