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APPLICATION OF CFD MODEL PARAMETER OPTIMISATION FOR GAS EXPLOSIONS

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Abstract: This paper reports the application of a method for optimising the predictive capabilities of a computational fluid dynamics (CFD) tool used for consequence analysis in the process industries. The objective is to investigate whether the procedure for surrogate-based optimisation of empirically determined sub-grid model parameters is applicable to the gas explosion application of a CFD tool. Furthermore, employing optimisation may detect model limitations, supporting the development of complex CFD models. The optimisation problem is formulated to yield the best fit between relevant outputs of a CFD model and corresponding experimental values for selected gas explosion experiments. The wide range of experiments are organised in categories such that experiments from each category represent similar physical phenomena. Optimisation for several campaigns within one validation category was conducted successfully in former work (Braatz and Hisken, 2017; Both et. al., 2017). However, in the application of the CFD tool, it might be impractical if for each category, there exist different optimal parameter values. Running a simulation for a new gas explosion scenario with the correct optimal parameter values would require identifying beforehand the category the scenario belongs to. Hence, in the present paper, results of optimising for several experiments across different validation categories are presented and discussed. It is shown that the optimisation process improves the model predictions satisfactorily. Both, A.-L., Hisken, H., Rückmann, J.-J., & Steihaug, T. (2017). Surrogate-based model parameter optimization based on gas explosion experimental data. Submitted to and accepted by Engineering Optimization. https://doi.org/10.1080/0305215X.2018.1450399
Braatz, A.-L., & Hisken, H. (2017). Response surfaces for advanced consequence models: Two approaches. Journal of Loss Prevention in the Process Industries, 49, Part B, 683-699.