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MODELLING AND SIMULATION OF A RACE-CAR FRAME USING GRAPH-BASED DESIGN LANGUAGES

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Abstract: Graph-based design languages aim at the holistic digital description of industrial products. Such languages are based on the structure of natural languages, in which vocabulary and rules define a language. Meanwhile, on the basis of such languages, a powerful engineering framework is now available. This framework aims at computer processing rules and reuse of design and production knowledge. Thus, it relieves product development engineers of routine work by generative means: Domain-specific models such as finite element models and CAD geometry models are generated with scripts (automatically) based on a central data model. The central data model is the core of the design language and holds all information necessary to generate all domain-specific models specified in the design language. This paper describes the use of this kind of design language for the embodiment and dimensioning of a frame for a Formula Student racing car. In the Formula Student regulations, certain load cases are specified and certain design rules are given by regulations. By representing the frame geometry in a design language, it is possible to automatically perform a digital function proof which always complies to the Formula Student regulations. The design can be automatically analyzed by generating a finite element analysis (FEA) with regard to the load cases in the regulations. As a first of its kind implementation, a sizing optimization for the tubes and plates of the car frame is automatically performed. This implementation extends the optimization design language, which has been presented at the WCSMO12 [1]. Being able to define both, topology optimization models and sizing optimization models, the outlook describes future applications of the optimization design language. [1] Ramsaier, M., Stetter, R., Till, M., Rudolph, S., Schumacher, A.: Automatic Definition of density-driven Topology Optimization with graph-based Design Languages, Proceedings of the 12th World Congress on Structural and Multidisciplinary Optimisation, Braunschweig, 5th -9th June, 2017