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AN OPTIMIZATION APPROACH FOR AN ULTRA EFFICIENT ELECTRIC RACING VEHICLE'S SUPPORTING SYSTEM BASED ON COMPOSITE SHELL ELEMENTS.

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Abstract: In a process of designing an ultra efficient objects, one of the most important issues is to minimize an overall resistance in each of its components. However, the process is complex and time consuming, as every element should be treated separately and a whole object must be also considered as a unity. With a usage of different optimization tools, a designer is able to obtain the best possible solution with given constraints and conditions. In this paper, an optimization approach for an ultra efficient electric vehicle is presented. The analyzed object is a supporting system for an electric vehicle powered by a hydrogen fuel cell designed by Smart Power Team from the Silesian University of Technology, which is dedicated to participating in Shell Eco-marathon competition, in a UrbanConcept class. During the race, not a total time is taken into consideration, but a total amount of used fuel, with the least, the higher position of a competitor. Therefore each subassembly of a vehicle must be optimized with a consideration of energy efficiency. In case of the supporting system based on shell elements, three main areas of optimization can be distinguished: body's shape, other subassemblies' placements and their connections to the system and an inner and outer structure of shell elements. As the supporting system is not a part of a drivetrain, its impact on the vehicle's total efficiency is not direct and can be analyzed mostly in consideration of its mass but also stiffness, which impacts on other subassemblies performance. Due to the fact that body panels are integrated parts of the supporting system, the shape optimization, mostly due to aerodynamic properties, was already conducted and is not a part of this paper. Moreover, the optimization process, based on topology optimization of the shell structure and laminates' thickness and plies' thickness and sequence was already conducted for the previous iteration of the outer shape of the vehicle, therefore most crucial areas of the structure have been already identified and basic methodology has been already developed. As the vehicle is driven with considerably low velocities and on a proper racetrack, loads introduced to the supporting system are relatively small and a loads structure is simpler than in case of a typical commercial vehicle.