

[Queen Mary Research Online](#) >  
[Queen Mary, University of London](#) >  
[Theses](#) >

**Please use this identifier to cite or link to this item:**

<http://qmro.qmul.ac.uk/jspui/handle/123456789/8295>

Title: Topology Optimisation in Crashworthiness Design via Hybrid Cellular Automata for Thin Walled Structures.

Authors: [Hunkeler, Stephan](#)

Keywords: Crashworthiness  
automotive design

Issue Date: 28-Feb-2014

Publisher: Queen Mary University of London

Citation: Hunkeler, S. 2014. Topology Optimisation in Crashworthiness Design via Hybrid Cellular Automata for Thin Walled Structures. Queen Mary University of London

Abstract: Crashworthiness design is one of the most critical areas of automotive design. It is really demanding for the structure and can therefore have a large influence on the final design. It is also difficult to model accurately and costly to simulate which has an important impact on the design process. Most car companies have now stopped addressing crashworthiness design with trial and error approaches, in favour of more advanced automated structural optimisation methods. While most relevant applications so far use size or shape optimisation, the ultimate way to achieve significant mass reduction is to use topology optimisation. However, topology optimisation methods for crashworthiness design are still a work in progress. Due to the high non-linearity of crash simulations, well-established classic topology optimisation methods cannot be applied directly to crashworthiness design. Alternative methods have been and keep being developed such as the Equivalent Static Loads method, the Ground Structure Approach or the Hybrid Cellular Automata (HCA). This thesis introduces an adapted version of Hybrid Cellular Automata using thinwalled ground structures. It combines the advantages of computing a real crash simulation while producing as an output a thin walled based topology needing minimal post-processing effort to be translated into a realistic design. In this method, the topology optimisation domain is filled up with a ground structure of thin walls which constitutes the elementary cells of the HCA method. These macro-elements replace the solid mesh elements used in the classic HCA approach. The details and implementation of the method are presented and discussed. Different application examples are detailed, including defining reinforcement patterns within extruded beams. Enriched shellings patterns are studied and industrial application examples are presented. Eventually, recommendations for further studies and applications of the method are given.

Description: PhD

URI: <http://qmro.qmul.ac.uk/jspui/handle/123456789/8295>

Appears in Collections: [Theses](#)