

# **Multidisciplinary Topology Optimisation: Where We Are and Where We Aim to Be**

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## **Abstract**

To date, topology optimisation has been single-disciplinary, mostly structural, with a growing number of attempts to do it in other domains, e.g. in the domains of fluid mechanics and electromagnetics simulation.

This tutorial reviews the state of the art in this area as well as reports recent developments of QMUL research group in multidisciplinary topology optimisation, e.g. fluid mechanics simulation interacting with solid mechanics simulation in a topology optimisation loop.

In order to address all requirements related to the individual disciplines in an optimisation problem, the optimisation strategy has to be separated from the disciplinary simulation runs, in which the objective function(s) and constraints are evaluated. A metamodel-based optimisation strategy is used because a single-disciplinary simulation time can be several hours (can even be a day+), so coupling it directly to an optimisation routine is infeasible. Pros and cons of different parameterisation types, including level set-based, will be reviewed.

This lecture will report the current progress of the QMUL's team including problems where a structural simulation (based on the finite element analysis) is combined with computational fluid mechanics simulation in the design optimisation loop.

The presentation will conclude with a review of specific features of adding other simulation types, e.g. electromagnetic simulation and aeroacoustics. Examples will focus on of real-life aerospace-related applications including on-orbit repurposing of space structures.