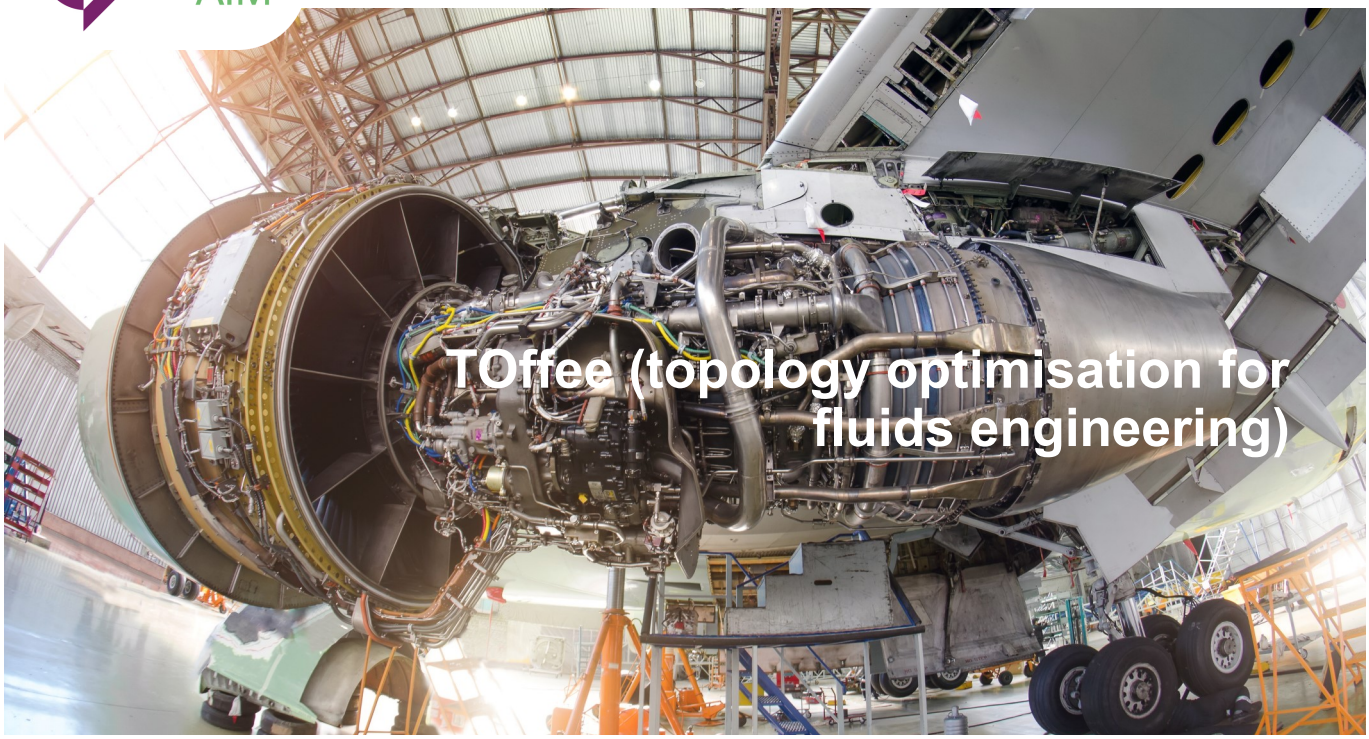
Take AIM

Smith institute
for industrial mathematics and system engineering



TOffee (topology optimisation for fluids engineering)

TakeAIM Winner 2017:
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Additive manufacturing (metal 3D printing) has given rise to previously unthinkable possibilities. Complex mechanical components can now be produced directly from digital models avoiding the limits imposed by traditional manufacturing techniques. Despite this great flexibility, aeronautical, mechanical and bio-medical industries keep using old and relatively inefficient designs for their products. A paradigm shift in the design approach is needed. Biological structures such as bones and veins are really efficient and nearly perfect.

I developed a design method able to emulate natural evolution and automatically design super efficient components for aircraft and cars. Not surprisingly, those new components bear striking resemblance to bronchial tubes. Fluid and structure interaction problems for aeronautics are at the core of my research. A key example: in order to survive under the huge thermal stresses due to fuel combustion, gas turbine blades are internally cooled by flowing coolant air. Bio-inspired designs for the internal structures of the blades increase the efficiency of the thermal exchange. Such an improvement would potentially double the life of the engine, increase the overall efficiency and reduce the emissions. In terms of maintenance and fuel, there would be an overall saving of hundreds of millions of pounds per aeroplane.

This research is leading to promising results in the gas turbine industry. Moreover, the versatility of the method makes it broadly applicable in automotive, chemical and civil engineering.

The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2017 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,250 of Apple vouchers, second prize £500 of Apple vouchers and six runners-up each received £150 of Amazon vouchers.