



Mathematically modelling a jet engine

TakeAIM Winner 2015:
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Will we ever see a silent aircraft? By 2100 it might well happen. Current regulations stipulate that by 2020 the effective perceived noise from aircraft must be half its level in 2000. One of the key noisy components is the jet engine, although there are many sources of noise. Building and designing a jet engine costs millions of pounds and furthermore to prove the jet engine is safe they have to be tested to destruction. Engineers and mathematicians are employed to design engines that will not only be quieter but will be more fuel efficient and produce fewer harmful emissions.

Reducing aircraft noise will require the development of many new technologies as well as radical designs. My research focuses on understanding the noise caused by the rotating fan in a current aircraft engine. I model the engine as a duct with acoustic lining, which damps some of the noise. I calculate the pressure in the jet engine by solving a differential equation obtained by rearranging the Navier-Stokes equations. For the first time, the pressure has been calculated analytically while considering lining in the duct and swirl due to the rotating fan.

Having measured the noise from an aircraft engine, engineers will be able to use my model of pressure to find the components which contribute the highest level of noise. This will allow them to focus their design efforts in the areas which will have the greatest impact on the overall noise of the aircraft.

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The use of mathematics has profound consequences in all walks of life, but the opportunities that it opens up often go unrecognised or underexploited. The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the fifth annual TakeAIM competition in 2015 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to all undergraduate and postgraduate students working in the mathematical sciences. The authors of the two best entries each received £1,000 of Apple vouchers as their prize, with £100 of Amazon vouchers being awarded to four runners-up.