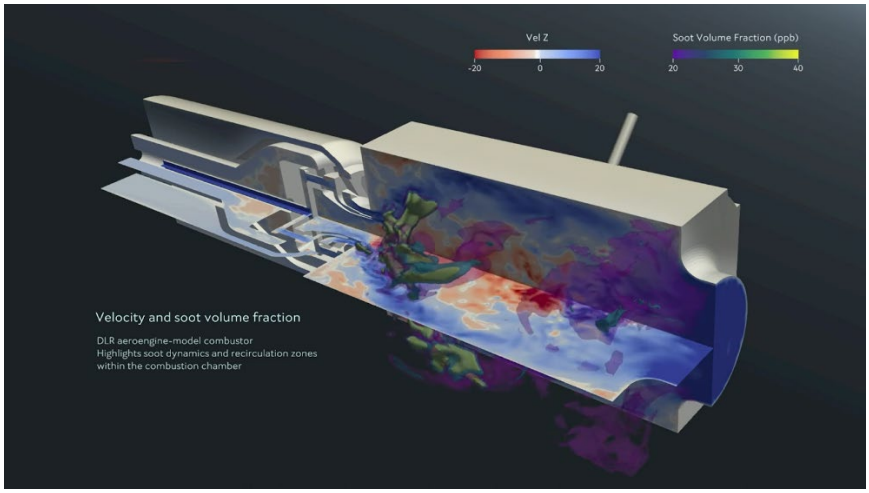
Helping the aviation industry design cleaner aeroengines

Barcelona, 25 October 2022 - Understanding and predicting the process of pollutant formation from aeroengines is a key aspect of mitigating aircraft emissions and helping the European Union achieve its 2050 climate neutral goals. Emissions such as soot, which are by-products of the combustion process of hydrocarbon fuels, can produce harmful effects on human health and contribute to climate change.

The aviation industry is a large consumer of fossil fuels and currently requires hundreds of billions of liters of fuel per year. Therefore, there is a need to develop more efficient aircraft engines, not only to reduce cost but also to decrease the dependency on fossil fuels and mitigate the negative effects of emissions on the environment and human health. These aspects have motivated a large effort to improve and optimize current combustion technologies for ultra-low emissions aircrafts.

ESTiMatE (Emissions SooT ModEl), a research project coordinated by the Barcelona Supercomputing Center and funded under the European Commission´s Clean Sky 2 Joint Undertaking, is contributing to the aviation industry by further understanding the fundamental processes involved in soot formation and by developing predictive models for aeroengine virtual testing and design. The academic partners are working closely with the aeroengine manufacturer Rolls Royce to ensure the findings of the project can directly benefit the aviation industry.

ESTiMatE developed an integrated approach using advanced experiments and computer simulations to predict soot particle formation and growth. First, the project looked into how different factors such as temperature, pressure and fuel composition can affect soot formation for Jet A-1, a kerosene-type fuel used in civil aviation. Then, predictive models were developed using experimental and numerical data from high-fidelity simulations. The goal was to evaluate the predictive capabilities of the different methodologies. As the project comes to an end, ESTiMatE researchers are happy to announce that they have been successful in the development and validation of these predictive models for soot formation, which should now be ready for testing in more realistic conditions.



A visualization of the dynamics of soot within a combustion chamber

“The work done in ESTiMatE is important in the process of aeroengine optimization and design,” said Dr. Daniel Mira, the project coordinator and team leader of the Propulsion Technologies Group at the Barcelona Supercomputing Center. “Traditional fuels such as Jet A-1 produce a large amount of soot when burned. We want to understand how these fuels perform in different conditions of pressure and temperature to develop efficient mitigation strategies for soot formation. Of course, there is still a long way to go before the aviation industry can develop net-zero emissions engines, but we are happy to contribute to this objective with fundamental knowledge and advanced emissions models that can support next generation engine designs.”

ESTiMatE coordinator Dr. Daniel Mira talks about how their research can contribute to better aeroengine optimization and design. (Image taken from the ESTiMatE video)

The ESTiMatE project, which runs from 1 November 2018 to 31 October 2022, is composed of seven European institutions: the Barcelona Supercomputing Centre (BSC), the Technische Universität Berlin (TUB), the Universitat Politècnica de València (UPV), the Technische Universiteit Eindhoven (TUE), the Technische Universität Darmstadt (TUDa), the Karlsruher Institut für Technologie (KIT) and the Universität Stuttgart (USTUTT), in collaboration with Rolls Royce (RR). The project has established a strong collaboration between industry and academia to develop advanced simulation technology that can be used to generate cleaner and more efficient propulsion systems.

Watch ESTiMatE partners explain how understanding combustion processes can reduce soot formation: https://youtu.be/t-GmCgOpYmk

Learn more about ESTiMatE’s research by visiting their website: https://estimate-project.eu/

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