



PEAK PERFORMANCE, POWERFUL SOUND

ALTAIR® ULTRAFLUIDX® SPEEDS UP DEVELOPMENT OF NEW MOTORBIKE MUFFLER DESIGN

About the Customer

Known as one of Europe's leading motorcycle manufacturers, KTM designs and develops ready to race offroad and street motorcycles. Research and development drive the company's innovation, enabling the continuous manufacturing of market-driven, safe, and high-quality products. To advance performance of KTM's class-leading bikes, the company's noise, vibration, and harshness (NVH) department leverages advanced technologies to ensure each motorcycle meets the highest standards of comfort, performance, and acoustic as well as mechanical quality.



With Altair ultraFluidX, we can quickly calculate many different variants of the exhaust system – easily, intuitively, and incredibly fast. Using simulation, we obtained meaningful results early on that correspond with the measurements. This enabled us to slash time, resources, and costs in the development process.

Gert Grillitsch, NVH Simulation Analysis & Testing, KTM Forschungs & Entwicklungs GmbH

Their Challenge

While achieving optimal performance remains the goal in motorbike development, each bike must also comply with a range of regulatory standards, including those governing sound emissions. Traditionally, compliance has been verified through physical prototypes and testing. However, because testing is both time-consuming and costly, many manufacturers are now adopting virtual testing to slash time and resources in the development process.

KTM's NVH simulation team has been using Altair solutions, including Altair® OptiStruct®, in numerous vibration and acoustic analysis projects. In developing a new exhaust system, the team's focus centred on evaluating the transmission loss of a new muffler design. Mufflers play an important role in motorbike development, as their design must balance competing requirements, such as the tradeoff between the driver's expectations of the exhaust sound, engine performance, and compliance with sound emission regulations. In this project, the key challenge for the KTM team was to achieve effective noise reduction while maintaining performance targets and customer expectations.

To achieve this, the team needed to predict the pressure distributions and damping characteristics of the new muffler design, allowing them to compare simulation results with real test bench data. To meet these objectives, they required a solution capable of performing detailed computational fluid dynamics (CFD) and computational aero-acoustics (CAA) simulations. The team identified Altair ultraFluidX as a suitable tool and initiated their first simulation runs.

Our Solution

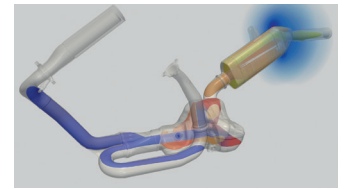
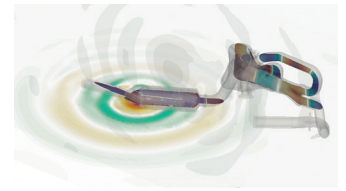
For the simulation, KTM used the transient CFD solver Altair ultraFluidX, an ultrafast aerodynamics simulation based on the Lattice-Boltzmann method. While the team had no prior experience with 3D-CFD analysis, they found the software intuitive and easy to use, enabling a quick and efficient simulation setup. Using ultraFluidX, KTM created a model of the complete exhaust system for a V2 engine, including two catalytic converters, two cylinders, two exhaust manifolds, a mid silencer, a muffler, and packing material, and then performed the simulation.

Despite the model's complexity, the model setup process was straightforward. Starting directly from the detailed production CAD model and without the need for meshing, the team completed entire setup just three hours before initiating the analysis. They then performed a transmission loss simulation, replicating the physical test bench condition: the two sources method (each host contains 2 microphones and a loudspeaker which, one per time, served as the sound source). To study the inputs and outputs, the team built a fully equipped model with complex geometry and subsequently analysed the frequency range to ascertain which frequencies were attenuated and by what amount. Getting first results was very easy, and ultraFluidX delivered highly accurate predictions of pressure distributions and damping characteristics, showing strong correlation with test-bench results.

Results

Altair's easy-to-use ultraFluidX solution enabled rapid modeling, allowing the KTM team to set up transmission loss simulations within a short timeframe. By comparing different design variants virtually – without the need to build corresponding physical prototypes – KTM drastically reduced both development time and costs. The software accurately predicted pressure distributions and damping characteristics that closely matched real test bench results.

With this new solution in place, KTM is now ready to advance to the next level of virtual prototyping, implementing active sound design at an early stage of the exhaust system development process.



TOP: Using ultraFluidX, KTM created a model of the complete exhaust system for a V2 engine, and then performed the simulation.
MIDDLE/BOTTOM: The software accurately predicted pressure distributions and damping characteristics that closely matched real test bench results.