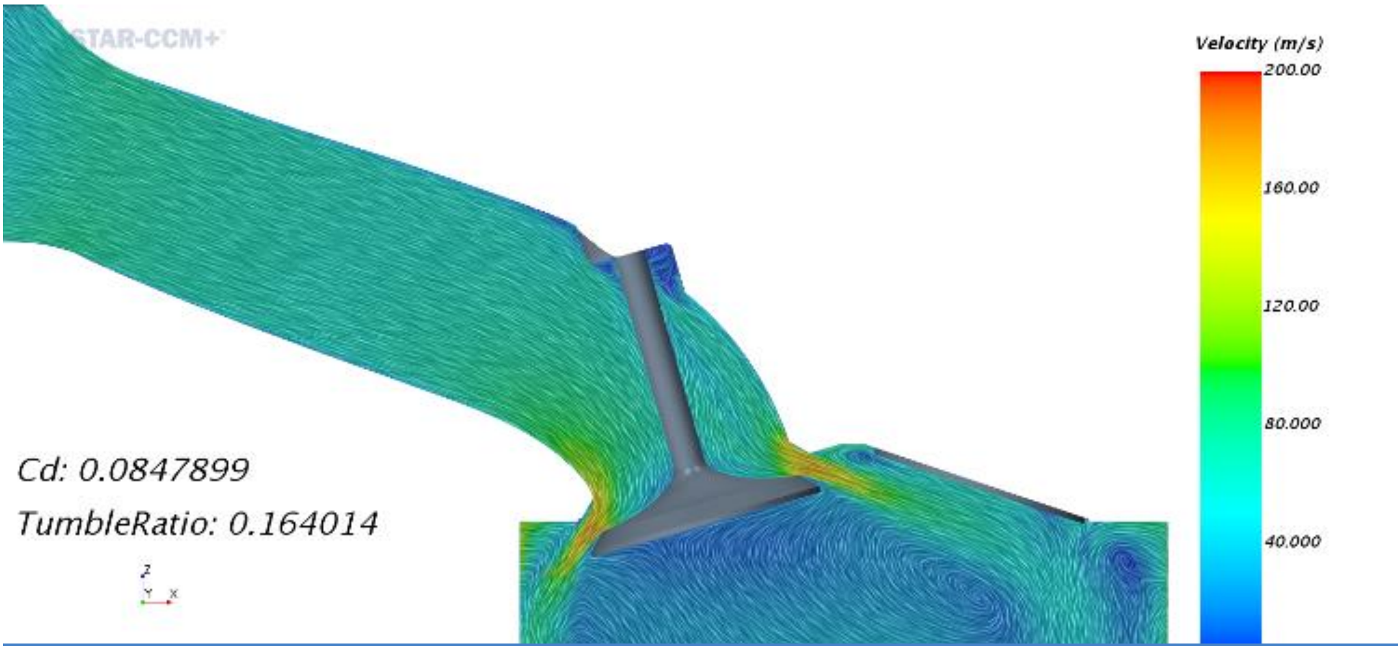
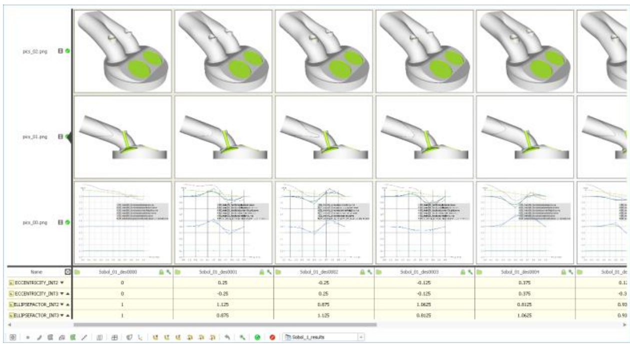


TECH BRIEF

INTAKE PORT DESIGN

CAESES® has been effectively used to design state-of-the-art intake ports and brings along several key capabilities for this specific task.

Intake ports are the final part of an engine's air induction system. They connect the intake manifold with the combustion chamber and are opened and closed with the intake valves.



Study of an intake port in CAESES

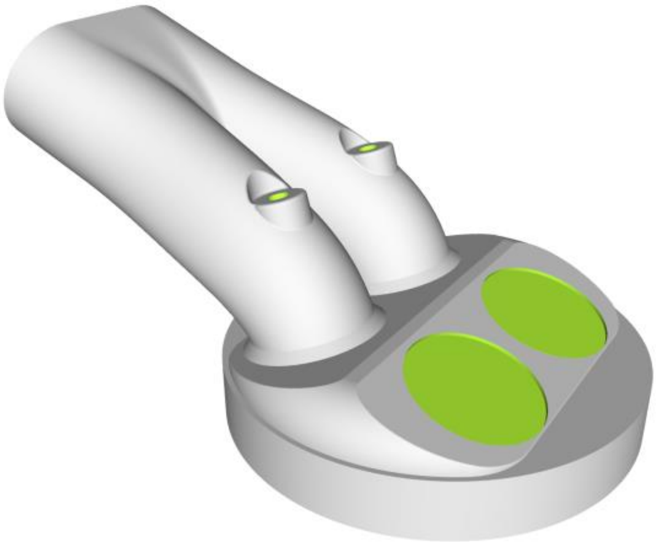
While intake ports are found in all types of engines, they have an especially pronounced influence on the air/fuel mixture formation in gasoline (SI) engines. In Diesel engines, the piston bowl also helps with that task.

Furthermore, the port shape is responsible for the charge motion, where favorably shaped vortices reduce energy dissipation, and it influences the amount of air that gets into the combustion chamber, where an increase leads to higher engine performance.

GEOMETRY MODELING

The main "duct" of the port is typically modeled using CAESES®' Meta Surface technology, where a parameterized cross-section is swept in a specified direction, e.g. along a path, and function curves control how the cross-section parameters change during the sweep.

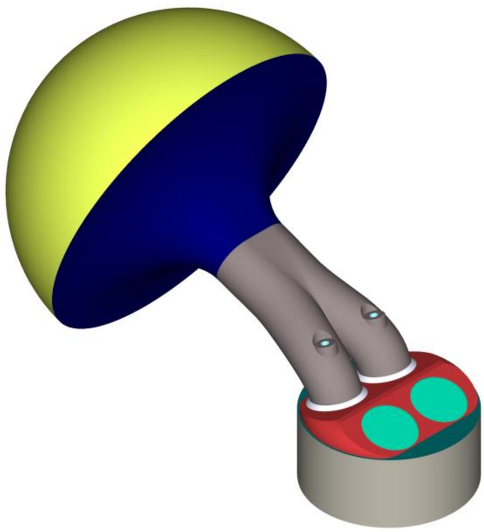
Arbitrary cross-section parameterizations can be used. This controlled-sweep approach brings along a high amount of flexibility, while keeping the number of design parameters as low as possible, for a faster optimization.



Parametric, variable geometry model in CAESES

FEATURES IN CAESES® FOR INTAKE PORT DESIGN

- The geometry parameterization can be set up so that flow-relevant parameters are directly controlled, e.g. the distribution of cross-sectional area along the path, even under consideration of blocking due to the valve guide or stem.
- Alternatively, morphing methods can be used to deform an existing – imported – geometry. This is faster, but less flexible and offering less direct control. The morphing can be applied to a NURBS surface geometry and be exported as IGES/STEP/etc., or to a discretized geometry such as meshes or tessellations.
- Robust variation of the port geometry is possible with no failed variants. As for other geometries, one of the most important targets of our software is 100% robust geometry variation, obtained by smart parameterization and dependency-based models.
- Arbitrary constraints can be built into the model or monitored. Typical examples are: manufacturing constraints such as drafting angles and minimal radii, or packaging constraints, where the distance to neighboring components/elements has to be maintained.
- The geometry can be exported in several different formats suitable for your CFD/meshing tools. Many of the formats support patch naming, so that the downstream tool can correctly identify surface patches for the assignment of individual mesh settings or boundary conditions.



Colored surface patches for automated export and meshing of the design candidates