



## LASER MICRO DRILLING OF AIRFOIL SURFACES FOR HYBRID LAMINAR FLOW CONTROL (HLFC)

### Task

The goal of the HLFC technology is to delay the airflow boundary layer transition from laminar to turbulent during cruise of a long-range aircraft. This reduces aerodynamic drag which leads to up to 10 percent fuel saving. Therefore, future airfoil surfaces shall be partially perforated with micro holes that are connected with a dedicated pneumatic suction system to stabilize the airflow. This system can also be utilized to blow hot air out of the holes for de-icing purposes. A drilling process by using laser radiation shall be implemented for the selected aerodynamic surface in order to obtain:

- hole diameter: < 100  $\mu\text{m}$
- aspect ratio: ~ 20
- hole density: ~  $2 \times 10^6$  holes/ $\text{m}^2$
- hole geometry: negative conical

### Method

A single-pulse drilling process with  $\mu\text{s}$ -pulsed single mode fiber laser radiation has been developed in order to meet the criteria of high productivity. The hole geometry is achieved by a suitable combination of pulse peak power and pulse duration. To compensate deviations of the real part with respect to the CAD data, an optical coherence tomography based distance measurement system with an additional z-axis has been integrated into the drilling optic. Thus, the focal position of the laser radiation is maintained on the surface of the part within acceptable tolerances.

### Results and Applications

By establishing an »on-the-fly« drilling process, a productivity of 200 holes per second could be achieved. The reproducibility of the drilling process is high with diameter tolerances within 10  $\mu\text{m}$ . By means of a CAD/CAM program the drilling process has been transferred to 3D components with a footprint of about 2 m x 1 m under a 6-axis gantry system.

The work in cooperation with Sonaca SA has been carried out in the framework of the EU Projekt »AFLoNext« and is granted by Wallonia within the »BASHYLA« project.

### Contact

Dennis Haasler M.Sc.  
Phone +49 241 8906-8321  
dennis.haasler@ilt.rwth-aachen.de

Dr. Arnold Gillner  
Phone +49 241 8906-148  
arnold.gillner@ilt.fraunhofer.de