German Aerospace Center

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Analysis of new approach trajectories at DLR: Flight test and ground-noise measurement campaign

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DLR's flying testbed, ATTAS (Advanced Technologies Research Aircraft System)

New noise abatement approach trajectories for conventional transport aircraft have been tested in flight by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). The trajectories under consideration promise ground-noise reduction along most of the flight path by relocating and concentrating high noise levels into selected areas. A new, high-precision autopilot for automated flight operation was installed onboard the test aircraft and operated in flight. These tests were accompanied by a dedicated noise measurement campaign to record the noise impact along the ground track of each flight procedure. In addition, the integration of the new procedures into conventional air traffic management was monitored from the airport's control tower. The campaign was organised and operated by DLR in close cooperation with the Institute of Aeronautics and Astronautics (Institut für Luft- und Raumfahrt; ILR) at the Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen University, and the German Air Traffic Control Service, Deutsche Flugsicherung GmbH (DFS).

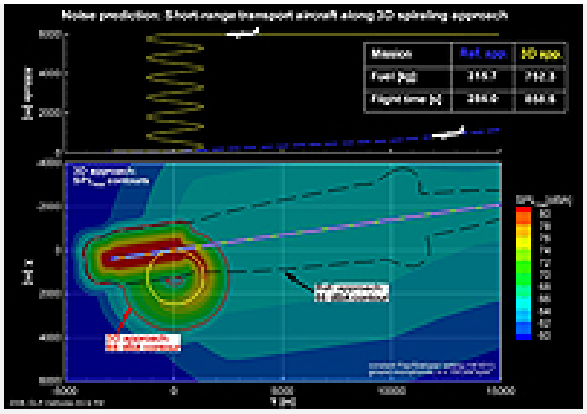
At DLR, a new simulation process was established for the environmental analysis of aircraft configurations. The process was applied to develop new approach trajectories for ground-noise reduction. A helical flight segment was implemented into a conventional approach path. Due to its shape, the new trajectory is referred to as a 'Helical Noise Abatement Procedure' (HeNAP). The flight path prior to the helical segment is shifted to higher flight levels; hence noise impact on the ground is reduced. High noise levels are relocated and concentrated within the area under the helix. Obviously, this limited area is exposed to increased noise levels. The noise concentration under the helical flight segment effectively reduces ground noise levels along the entire preceding flight path.

Flight test of the new autopilot along selected approach trajectories

The flight tests were operated with DLR's 'Advanced Technologies Testing Aircraft System' (ATTAS). The flight control system onboard ATTAS allows for easy implementation and flight-testing of experimental flight control procedures. A new high-precision autopilot from the DLR Institute of Robotics and Mechatronics (Institut für Robotik und Mechatronik) was installed onboard to evaluate its behaviour in flight. This autopilot allows for fully automated and highly accurate tracking of flight trajectories, including HeNAP. Helical Noise Abatement Procedures are very challenging flight procedures even under constant wind conditions. Therefore, this application is a benchmark test of the autopilot's performance.

The dedicated ground noise campaign was organised by the DLR Institute of Aerodynamics and Flow Technology (Institut für Aerodynamik und Strömungstechnik) in close cooperation with ILR at RWTH Aachen University. The necessary technical equipment for the noise measurements was provided by ILR. The air traffic controller workload and the air traffic integration of the new procedures were monitored by DFS.

Validation of the predicted ground noise distribution along the helical approach path



Simulated results for a transport aircraft following two different approach procedures

Three approach trajectories were flight tested and evaluated. The test program was made up of conventional, steep and helical approaches. The new autopilot worked very well and was able to keep the aircraft precisely on the desired flight path, despite strong winds and turbulence. Initial analysis of the noise data confirms the predicted relocation and concentration of high noise levels along only the helical flight segment. Along the flight path prior to the helix, the anticipated ground noise reduction was achieved.

Due to the helical flight segment, fuel consumption and flight time would increase to some degree. Obviously, a trade-off between a significant noise reduction and increased fuel consumption and flight time becomes inevitable.

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