ENABLING AVIATION SAFETY

ALTAIR SOLUTIONS ENABLE PRECISION AUTO-LANDING AT COMPLEX AIRPORTS

About the Customer

Founded in 1993, the German air navigation service provider Deutsche Flugsicherung GmbH (DFS) ensures the safety of German airspace and beyond. DFS's technical innovations cover the whole spectrum of air navigation services – from automatic speech recognition used in training, to support air traffic control systems, to satellite-based approach and departure procedures. To drive technological innovation together with European partners, DFS joined forces with the air navigation service providers of Belgium, France, Luxembourg, the Netherlands, and Switzerland – where navigation provider Skyguide ensures that Swiss air navigation technology remains at the forefront. To take a leading role in terms of safety, innovative technology, and economic efficiency, DFS leverages Altair's advanced technologies to reduce the time and resources needed to develop technical systems.

> "Altair solutions empowered us to verify GBAS radio coverage at different heights on and around the airports, providing us with accurate results that help us enable safe air navigation. Accounting for new buildings, even before they are built, or interferences from other radio frequency sources, enables us to ensure a clear, reliable high-quality signal for accurate navigation information and ultimately, for a first-class aviation safety.
>
> Dr. Ralf Eichhorn, senior expert, DFS Deutsche Flugsicherung GmbH

Their Challenge

Today, most airport navigation systems rely on the Instrument Landing System (ILS), a ground-based navigation system that provides precise guidance to aircraft during approaches and landings. Unlike the ILS, which is based on two main components – the localizer and glidepath – the new Ground Based Augmentation System (GBAS) uses a single airport ground station to transmit corrected Global Navigation Satellite System (GNSS) data to suitably equipped aircrafts. Compared to the ILS, the GBAS advantage lies primarily in the variety of approach procedures offered with a single system.

Because a GBAS relies on radio signals to offer digital guidance for high-precision approaches, it's crucial to ensure a clear, reliable signal for accurate navigation information. In addition to interference from other radio frequency sources that can affect the signal's quality, signals reflecting off surfaces such as buildings or terrain can cause multipath interference that causes signal inaccuracies. In a joint project with Skyguide, DFS needed to verify GBAS radio coverage at different heights on and around the airports of Frankfurt, Munich, and Zurich to ensure reliability. To evaluate possible locations and/or modifications to the GBAS station, DFS's engineers needed an approach that allowed them to study the potential impact of new buildings on the radio coverage around the airports.

Our Solution

Based on their experience from previous projects, the DFS team used Altair solutions to ensure reliable operation of the GBAS station at complex airports. Using Altair® Feko®, including Altair® WinProp™ and a model of the Frankfurt airport – one of Europe's largest – the engineers calculated the wave propagation to predict GBAS's signal strength and study the potential impact buildings would have on that signal and radio coverage.

Before the GBAS system study, DFS verified the highly accurate WinProp results for their very high frequency data broadcast (VDB) system, which is also installed at the Frankfurt airport. For this purpose, the team imported 450 buildings provided by Fraport, an airport company, to build a complex airport model that included details such as the building footprint extruded to the highest roof to be able to calculate the electrical field strength of the defined GBAS transmitter stations. To account for the airport's complex topography, the team prepared a digital elevation model (DEM) representing the Frankfurt airport terrain to superpose the building layer to the topography. For the provision of a 3D antenna radiation pattern, WinProp offers various methods to extrapolate from given 2D patterns, including the Weighted Bilinear Interpolation (WBI) method.

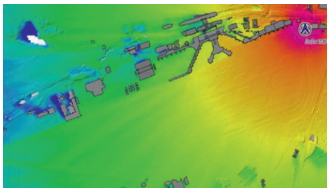
The predicted power levels from WinProp's 3D ray tracing engine showed a good correlation with the VDB power level measurements (+/- 3 decibels) on the main runway and the taxiways. These results provided confidence in the validity of the ray-optical wave propagation modeling based on an accurate environment description, including 3D building vectors, vegetation, and topography.

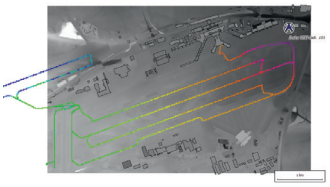
After this successful evaluation the team performed various simulations using WinProp's 3D ray tracing engine, considering multipaths, for evaluating the radio coverage of the GBAS station.

Results

By using Feko and WinProp, DFS and Skyguide verified GBAS radio coverage at different heights on and around the airports of Frankfurt, Munich, and Zurich. Altair's tools allowed the team to calculate GBAS signal levels without needing to simplify the environment, resulting in an accurate signal propagation model. Additionally, the team can use this simulation strategy to assess how future structures, such as airport towers and docks, might affect radio coverage. This foresight enables the effective evaluation of alternative locations or adjustments to the GBAS station, ensuring optimal decision-making before construction begins.

As a result, simulation empowered DFS and Skyguide to develop GBAS stations with confidence and enable safe, precise auto-landings – helping create a safer, more efficient global aviation transport system.





TOP: Based on an accurate environment description, including 3D building vectors, vegetation, and topography, WinProp's 3D ray tracing engine predicted the signal levels around the Frankfurt airport. **BOTTOM:** The predicted power levels from WinProp's 3D ray tracing engine correlated (+/- 3 dB) with the measurements on the main runway and the taxiways, which provided confidence in the validity of the ray-optical wave propagation models included in WinProp.

> Altair WinProp enables us to assess the impact of buildings on the Zurich Airport radio coverage prior to their realization. The inclusion of multipath propagation is essential because fast fading plays an important role in the modeling of the radio communication of slow-moving or stationary aircraft.
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> Dr. Pascal Truffer, CNS expert, Skyguide