

Noise measurement on helicopters in flight

Measurements on helicopters in flight have been performed in order to improve the data base used in computer simulations of helicopter noise. Because the directivity characteristic of helicopters is far more complex than those of fixed wing aircrafts, a new method was developed to derive the parameters of the mathematic model.

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Since the late eighties the noise impact by aircraft has been calculated at EMPA with the simulation program FLULA. This program is based on the concept of a sound source, placed consecutively in discrete positions along the flight path. In order to perform realistic simulations, the sound power and directivity characteristic of the source have to be known. A well established data base for the noise simulation of fixed wing aircraft exists at EMPA. But so far no valid source data for helicopters has been collected. In order to expand the data base on helicopters, extensive noise measurements on three helicopter types have been performed. As helicopters have different noise characteristics compared to fixed wing aircrafts, a new method had to be developed to derive and to describe the directivity characteristic from the measured noise data.

Measurements have been performed on the Turtmann airfield on the three helicopter types Super Puma AS332, Alouette III SA316 and Agusta A109K2. For more than 400 flights, the sound pressure was recorded simultaneously with 20 microphones, placed in an U-shaped array of 150 m width and 50 m height. The microphones on the side of this array have been fixed with the help of two huge mobile cranes (Fig. 1). Simultaneously to the sound measurement, the exact position of the helicopter was determined by a precision radar system. In addition, the orientation of the body of the helicopter was measured with a fiber-optic gyroscope. Measurements were synchronised by the signal of the radio clock DCF77 in Frankfurt.

By means of the measured data and the knowledge of the exact position of the helicopter, the parameters of a mathematic model describing the directivity of the sound emission for different flight operations have been derived. In contrast to the procedures used for fixed wing aircraft, where the directivity pattern is parametrised by a rotational symmetric model, the new model is based on spherical harmonics. With this model it is possible to de-



Fig. 1: Alouette III passing the microphone array on the Turtmann airfield.

scribe the full three-dimensional directivity of the noise source. Fig. 2 shows an example of the lower hemisphere of the resulting A-weighted noise levels for $R = 305$ meters for a Super Puma AS332 for the operation "Departure". With this method, the parameters describing the directivity pattern of the three measured helicopters have been derived for different flight procedures.

As a result of these measurements, there exists now a realistic model to simulate the noise impact of helicopters. Whether this three-dimensional model can be applied to fixed wing aircraft has still to be investigated, though.

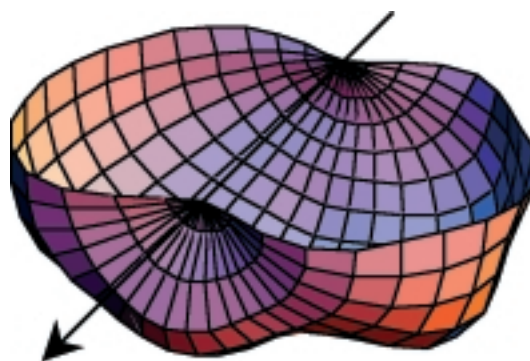


Fig. 2: Graphical representation of the lower hemisphere of the A-weighted directivity pattern for the helicopter Super Puma AS332 "Departure" at $R = 305$ meters. The arrow indicates the direction of flight.

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References: W. Krebs et al., 17. Int. Congr. Acoustics., ICA, Conf.Proceed. (2001)