

3D-Audio-Düker

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A space not normally accessible to the public — the Donau-Düker, a tunnel under the Danube — is being acoustically "reproduced" in three-dimensional audio [also known as virtual acoustic or binaural acoustic] to enable listeners to experience via headphone the unique tonal qualities of this place.

The configuration of a virtual acoustic space is done in a manner similar to that of 3-D visual animation. Recordings of actual sounds occurring in the Düker [acoustic objects such as the noise made by the propeller of a passing ship or the steps of someone walking through the tunnel] are animated by means of a three-dimensional path [3-D spline] recreating the original movement of the sound, and are spatially projected via headphone. "Observers" assume the same position as the microphone during the recording process, such that the "line of vision" runs along the length of the tunnel [in the direction of Urfahr on the north bank of the Danube]. Thus, a ship sailing downriver [from west to east] approaches from the upper left, proceeds overhead and withdraws to the upper right; someone walking through the Düker [from Linz in the direction of Urfahr] approaches from the rear and proceeds past on either the left or right.

In the case of the scenario described above — as with every other — individual listeners experience various different distortions of perception with respect to the position and the movement of the sound source within the virtual acoustic space. The degree of [spatial] distortion is determined by several individual factors. The simulation of a three-dimensional acoustic space projected through two loudspeakers is accomplished by means of spectral modification [convolution] of the sound. In addition, there is the application of transfer functions, generally referred to as "head-related transfer functions" [HRTFs] or "free-field-to-ear transfer functions." These transfer functions must be individually derived in an extremely time-consuming procedure — what actually takes place is the transformation of the physiological preconditions for the reception of acoustic signals into mathematical functions, and this is done for every point within a spherically shaped raster. For this reason, recourse is usually taken to previously existing HRTFs, as has also been the case with this installation. Of prime concern is the fact that these transformations contain functions of the position — as well as the thoroughly individual functions of the auditory characteristics — of the individual from whom the HRTF was derived. Decisive factors determining individual auditory characteristics are head shape and size, as well as the formation of the outer and inner ear. The degree to which the above-listed individual auditory factors inherent in the HRTFs coincide with those of the listener constitutes the limiting quantity with respect to distortion in the perception of sound direction.

Düker [German]: A pipeline running beneath a river, canal or tunnel; based on the [physics] principle of communicating tubes.