Measuring the Surface Accuracy of the Effelsberg 100-m Radio Telescope

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As described by Ruze (Proc. IEEE 54, p. 633, 1966), the gain of a radio telescope does strongly depend on the surface accuracy of the main dish. When a large reflector is being tilted, gravitational effects lead to changing deformations of the surface, which have to be taken into account for a proper calibration of the astronomical observations. Therefore, the design of the Effelsberg 100-m radio telescope incorporated a specific construction scheme, called "homologous distortion": With changing elevation, the deformations of the dish led always to a new paraboloid (with different focus position).

In 2013, an accurate determination of the main dish parabolic surface of the 100-m telescope has been performed with a laser scanner mounted in the prime focus of the antenna. For the first time, it was possible to measure directly the changes of the focal path length and the remaining non-homologous variations of the surface accuracy with changing elevation angle.

Here, we present the results from the laser scanning and compare these with earlier observations using radio astronomical measurement techniques like the conventional holography (restricted to one elevation) and more recent observation by means of the „Out-of-Focus"-technique.

From the measurement of the surface RMS at various elevation angles, we derived the elevation dependence of the telescope's gain and compared these values with the gain-elevation curves determined by the observation of astronomical sources.