

Novel Technique of Radar Interferometry in Dynamic Control of Tall Slender Structures

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ABSTRACT:

Structures of slender shape, like guyed masts, chimneys or TV towers, are exposed to the excitation of dynamic movements. The most common cause of vibration is the wind that induces generation of vortices. Another important reason is a sudden strike from seismic or paraseismic forces. Structure exposed to wind impact is subjected to harmonically various force, perpendicular to the air stream, which is an effect of vortices, shedding on alternate sides of structure. Because of the possibility of vibration the damping of a structure has to be designed. Measuring of decay in the oscillation allows to find the logarithmic decrement of the real structure and compare it with the designed value. Apart from damping, the proper designing of tall slender structures has to preserve the significant difference between vortex shedding frequencies and the natural frequencies of the structure shape modes. In the case of guyed masts it is important to analyse the response of a real structure to the exceptional dynamic load, such as a sudden break of guy or fall off a load from a structure, e.g. icing or antennas. The dynamic analysis of a real structure requires the accurate values describing the dynamic behaviour of tall structures (e.g. amplitudes). The accuracy of 0.1 mm is provided by ground-based interferometric radar. This device is a part of the IBIS-S system, which calculates the displacement values on the basis of the difference between phases of waves received in consecutive samples. Typically, the measurements of tall structures are performed with several sensors (strain gauges, accelerometers). Instead, the IBIS-S system allows the quasi-continuous (not limited to points) observation of the entire structure without installation any sensors or reflectors. The real resolution (along the structure), which means the minimum distance between two observed points, amounts up to about 0.7 m.