Determination of the natural frequencies of vibration of geodetic pillars with a COST seismometer

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The design and construction of geodetic monumentation in an observatory is not a common event, linked to the installation of new instrumentation with working lives counted in decades. Since the performance of this instrumentation is affected by the physical behaviour of its supporting monumentation, it is worthwhile to devote sufficient efforts to ensure that the design is adequate and will not prove to be a limiting factor in the long term. Questions such as the stability, longevity, thermal behaviour, cost and practicalities of different kinds of installations have been thoroughly considered for GNSS monumentation. Owing to their much rarer deployment, the optimal properties and characteristics of pillars of big dimensions, e.g. for SLR, appear less widely known and standardised. Of special consideration in these cases are the natural frequencies of vibration of the structures, as they must provide support for mechanical mounts whose control loop might be adversely affected, or even rendered hopeless, if a sufficient stiffness were not achieved. In the design phase of the new SLR station at Yebes Observatory, a study of this issue was commissioned to an engineering firm. Concurrently, consideration of the problem led us to conduct an experiment to determine the vibrational frequencies of existing pillars in the Observatory. We performed the measurements with a seismometer developed in-house based on COTS 3-axis MEMS accelerometers, with which we determined the vibrational frequencies from the impulse response of a pillar in the VGOS radio telescope. The expected theoretical values for simplified cylindrical structures agree reasonably with the measurements. The measurement method can be applied to structures of any complexity that might need testing for their suitability, and we will employ it to measure the frequencies of the Yebes SLR pillar.