Self-noise measurements of the Streckeisen STS-2 seismic sensor

Knowledge about seismic instrumental noise is crucial in any interpretation of digital, seismic recordings. The "three-channel correlation technique" is a new method to measure the self-noise of seismic instrumentation in a wide frequency range. This new technique has been successfully applied on seismic data recorded in the Conrad Observatory to reveal the self-noise of the STS-2 sensor. At frequencies above 0.5 Hz the STS-2 sensor is much more quiet (10 - 15 dB less noise) than assumed before.

The self-noise of a seismic instrument is a fundamental characteristic, used to quantify the quality of the instrument. This information is relevant as it reveals under which conditions the interpretation of data may be biased by the seismic instrumentation. Recently, a new technique (Sleeman, 2006) was developed to extract the self-noise of seismic sensors, using 3 collocated co-aligned sensors. The novelty of this method is that it extracts the sensor self-noise only from the measurements and does not require a priori information about the dynamic behaviour of the sensor.

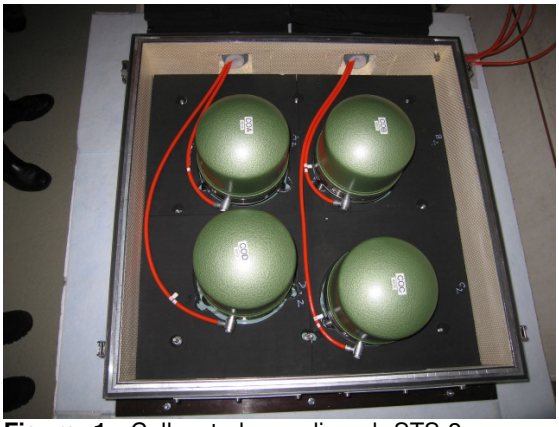

Figure 1: Collocated, co-aligned STS-2 sensors with a new type of thermal isolation (neoprene) at an intermediate stage of the installation.

The EC project NERIES (Network of Research Infrastructures for European Seismology) and the excellent laboratory facilities at the Conrad Observatory, Austria, offered the infrastructure and instrumentation to carry out a unique, long term experiment to extract the self-noise of the STS-2. The installation of the STS-2 sensors was done on one of the piers in the tunnel. A new type of thermal isolation, consisting of thin layers of neoprene around the sensors (Fig. 1), was used to prevent noise contribution due to air convection around the sensor.

The results in Figure 2 show that the STS-2 noise is far below the U.S. Geological Survey seismic low noise model (NLNM) for a large frequency band. Above 0.5 Hz the sensor has less self-noise than was measured with the older technique using 2 collocated sensors. The small variability in the extracted self-noise reflects the robustness of the method, the high quality of the installation and the stable site conditions.

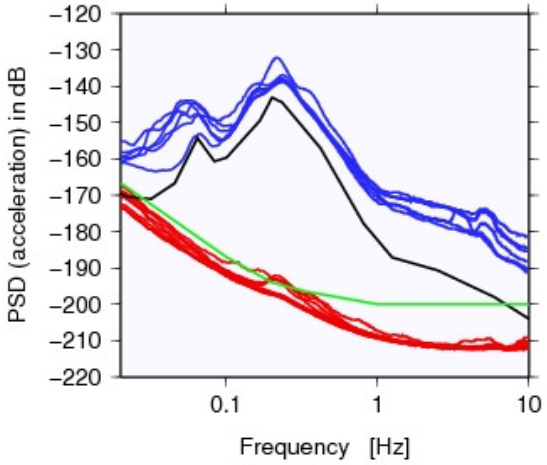

Figure 2: Red: STS-2 self-noise (this experiment); Blue: background noise in the Conrad Observatory; Black: low noise model NLNM; Green: STS-2 noise (old technique).

The NLNM is used as reference for studies on ambient Earth noise or to compare seismic recording sites. However, not all features are understood and some parts may be biased by recording systems. This new technique, as well as the new STS-2 noise measurements may contribute to validate and understand some of the fundamental features of the NLNM.

References:

R. Sleeman, A. Van Wettum, J. Trampert, 2006. Three-Channel Correlation Analysis: A New Technique to Measure Instrumental Noise of Digitizers and Seismc Sensors. *Bulletin of the Seismological Society of America, Vol. 96, No. 1, 258-271.*

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