

## **Advances in Güralp Broadband Sensor Technology to Improve Deployment Workflows**

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Broadband seismometers have traditionally used an analogue force-feedback design to increase the linearity and dynamic range of the sensor. However, a drawback of this design has been the large masses required to improve noise performance which inherently has made broadband seismometers cumbersome. In addition, traditional broadband seismometers have required the sensor to be accurately levelled and unlocked once deployed.

Over the last 5 years, Güralp Systems have developed a new robust sensor technology that makes use of a digital feedback loop that ensures consistent performance regardless of the angle of instrument tilt. This novel sensor technology requires no mass locking and has implications in a range of research areas, including ocean bottom, borehole and near surface seismology.

The integrated digital feedback system allows for the sensor's long period corner to be adjusted remotely, allowing users to effectively have multiple sensor types in a single package. This feature in particular makes Güralp's next generation sensors incredibly versatile tools, especially for operators with limited resources. The integration of the Minimus digitizer allows for users to intelligently select crucial operating features to reduce the power consumption of the systems significantly, reducing the power requirements for remote deployments.

This omnidirectional sensor technology has been in development since 2016 with the development of the Radian borehole system, where the omnidirectional capabilities are particularly useful for existing boreholes that may not necessarily be vertical. The sensor technology was then integrated in to the Aquarius, a free fall OBS system that utilises the functionality to maintain performance regardless of the orientation of the system when it reaches the ocean floor. More recently, the sensor has been developed into compact surface systems as either a digital unit, the Certimus, or as an analogue posthole unit, the Certis.



Figure 1: Certimus digital seismometer being deployed as an angle in a shallow direct burial installation.