Application Of The Reverse Vertical Seismic Profile – Seismic While Drilling Method In Space Mission

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Abstract. The possibility to obtain Moon (or other celestial body) local subsurface structural and stratigraphic information while drilling is of great interest for the relevant missions.

The Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) has researched and developed its own drill-bit reverse vertical seismic profile (RVSP) seismic while drilling (SWD) method and automated technology for application in oil exploration wells in cooperation with Oil industry (Eni). The OGS intellectual property (IP) on SWD is protected by the patent EP609949 entitled "Process and device for detecting seismic signals" shared with Eni. In addition, OGS performed SWD also to monitor drilling of geothermal wells and to predict risks during Tunnel mechanical excavation.

The paper will describe the proposal for the application in space missions of the invention that performs the RVSP SWD by using the working drill bit as a borehole source of seismic waves. The method is intended to be applied to a drill for moon/space exploration developed by Galileo Avionica; the resulting drilling scenario is schematized in figure 1. The aim is to obtain information about the unknown subsoil to be drilled ahead, to identify and localize buried obstacles and rock layers, i.e. formations with different acoustic properties, and to avoid drilling risk and steer the drilling plan in near-real time by automated and/or remote control. Also, the remote control of a future actual flight system, will require strong supervisory capabilities. Remote control facilities may provide higher computation power than traditional embedded on-board control computers. Advanced integration of remote and on-board control, usually arranged in a hierarchical way, is fundamental for unmanned interplanetary missions. This is particularly true for the Moon exploration case, where communication latency time is not negligible and human real-time direct intervention on the system is not possible. A remote supervisor prototype will also be utilised, developed by Telespazio and OGS, as described in the paper, in order to:

- Process input test data (raw and pre-processed data).
- Provide drill system behaviour predictive analysis.
- Provide indications to the drill human operator about how to safely operate the tool.
- Provide formatted output for data distribution.

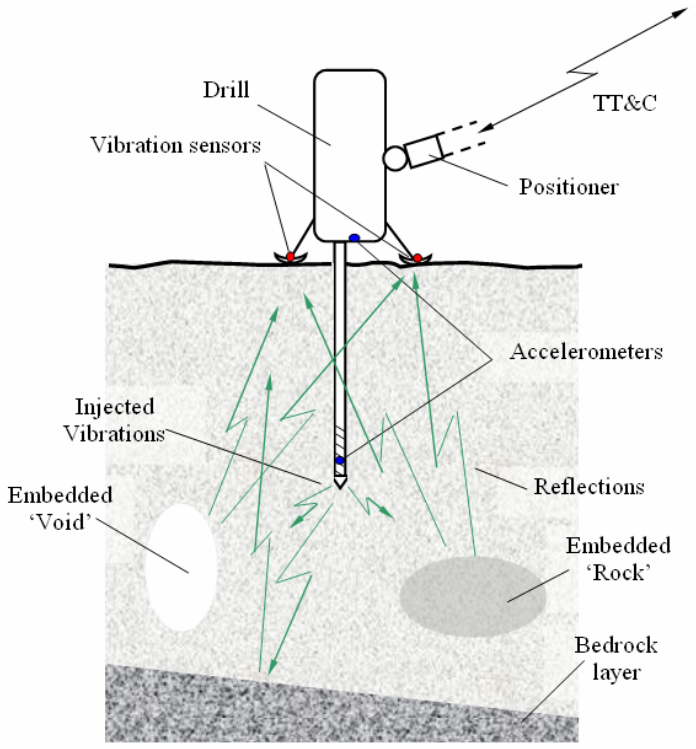

FIGURE 1. Schematics of drill bit SWD proposed method (not to scale)

ACKNOWLEDGMENTS

The OGS intellectual property (IP) on SWD is protected by the patent EP609949 entitled "Process and device for detecting seismic signals" (Angeleri et al, 1994) shared with Eni. In the framework of the SWD projects, OGS and ENI developed the owned SWD technology registered as SEISBIT®.

REFERENCES

Patent EP609949 entitled "Process and device for detecting seismic signals" (inventors Angeleri, G. P., Persoglia, S., Poletto, F., and Rocca, F., 1994), filled by OGS and Eni.

Honorable Mention of the Society of Exploration Geophysicists for the paper "Drill-bit signal separation for RVSP using statistical independence: Geophysics.", by F. Poletto, Rocca, F. and Bertelli, L., in the selection of the Best Paper in Geophysics, Vol. 65, 2000.

Honorable Mention of the Society of Exploration Geophysicists for the paper "A new approach to offshore drill-bit RVSP: Geophysics.", by F. Poletto and G. Dordolo, In the selection of the Best Paper in Geophysics, Vol. 67, 2002.

Book "Seismic Wile Drilling – Fundamentals of Drill Bit Seismic for Exploration", Elsevier, vol. 35, 2004, by Poletto F. and Miranda F.

PRINCIPAL AUTHOR'S BIO (~50 WORDS)

Flavio Poletto (born in Italy, 1952). Laurea in Fisica (University of Trieste, 1988). Senior Geophysicist at OGS. Working in seismic data processing (1984), from 1988 at SWD research using the drillbit noise for RVSP. Author of patents on the seismic use of the drill-bit-noise. Awards in 2001 and 2003 (Honorable Mention for papers selected in the category of the Best Paper in GEOPHYSICS). Author of many scientific papers and of a book on SWD (2004). Currently coordinator of the OGS SWD project, which includes borehole geophysics research, applications extended to drilling diagnostics and geosteering, seismic interferometry and Tunnel SWD.