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Acoustic monitoring of radial water drilling progress

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The radial water jet drilling technology is used to increase the inflow into insufficiently producing geothermal wells. During radial water jet drilling, laterals are jetted into a target formation using an existing well. A focused water jet is applied to the rock through a nozzle attached to a coiled tubing. The method is applied to access and connect high permeability zones within geothermal reservoirs. However, the geometry of the jetted path is not measured during default applications. Techniques for determining the geometry of radial paths can be adopted from equivalent applications in the oil and gas industry, where we can distinguish between direct measurements with tools being fixed to the drill bit, and indirect measurements where sensors are remotely installed. Such sensors record the acoustic emission field, which is inverted towards drill bit position as a function of time. During radial water jet drilling, a continuous source signal is induced. In this study we will explore the potential of inverting the acoustic wavefield generated by the nozzle, towards a nozzle source location as a function of time. We specifically focus on inverting the continuous signal to a location of the nozzle using a method analogue to drill-bit interferometry. We use experimental data acquired in a quarry in Gildehaus (Germany) with a set-up mimicking a downhole application where sensors are placed vertically along the well. Here several jetting tests were conducted, while acoustic data was acquired with seismic accelerometers and piezo-elements. We consider the acoustic signatures of data acquired during jetting tests and address the localization outcomes of the accelerometer and piezo-element data, as compared to in-situ geometry measurement.

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