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Thermal modeling of bore fields with arbitrarily oriented boreholes

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The accurate prediction of the thermal behavior of bore fields for shallow geothermal applications is necessary to carry out a proper design of such systems. A classical methodology to perform this analysis is the so-called g-function method. Most commercial tools implementing this methodology are designed to handle only bore fields configurations with vertical boreholes. This is a limitation since this condition might not apply in a real installation.

In a recent development by the author, a semi-analytical method to determine g-function for bore fields with arbitrarily oriented boreholes was introduced. The strategy utilized is based on the idea introduced by Cimmino of representing boreholes as stacked finite line sources. The temperature along these finite lines is calculated by applying the superposition of the effects of each linear heat source in the field. This modeling technique allows to approximate uneven heat distribution along the boreholes which is a key feature for the calculation of g-functions according to Eskilson's boundary conditions.

The method has been tested for a few simple configurations and showed results that are similar compare to previous results computed numerically by Eskilson. The method has been then successfully applied to the g-function calculation of an existing large scale highly asymmetrical bore field.