Advanced Hybrid Model for Borefield Heat Exchanger Performance Evaluation, an Implementation in Modelica

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Accurate and computationally efficient borefield models are important components in building energy simulation programs. They have not been implemented in Modelica so far. This paper describes the implementation of an innovative approach to model borefields with arbitrary configuration having both short-term (minutes) and long-term accuracy (decades) into Modelica. The model allows coaxial, single and double U-tube borehole types.

A step response is calculated using a combination of a short-term response model which takes into account the transient heat transfer in the heat carrier fluid, the grout and the immediately surrounding ground, and a long-term response model which calculates the boreholes interactions. Moreover, an aggregation method is implemented to speed up the calculations and to make the simulation time independent of the number of boreholes. Thanks to its aggregation method, the implemented model is about twelve times faster than the borehole model of the Buildings library [1] for the case of a single borehole and about 60 times faster for the case of three boreholes in series (see Fig. 1).

Validation shows good results and very high computational efficiency.

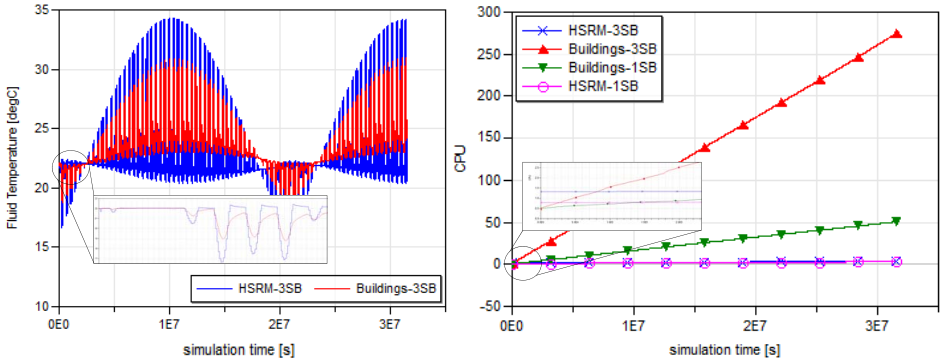

Figure 1: Left: CPU comparison between the new model (*HSRM*) and the model form the Buildings library (*Buildings*) for a single borehole (*1SB*) and for three boreholes in serie (*3BH*). Right: heat carrier temperature for *HSRM-3BH* and *Buildings-3BH*.

References

[1] M. Wetter, W. Zuo, T. Nouidui, and X. Pang. Modelica buildings library. *Journal of Building Performance Simulation*, 0:1–18, 2013.