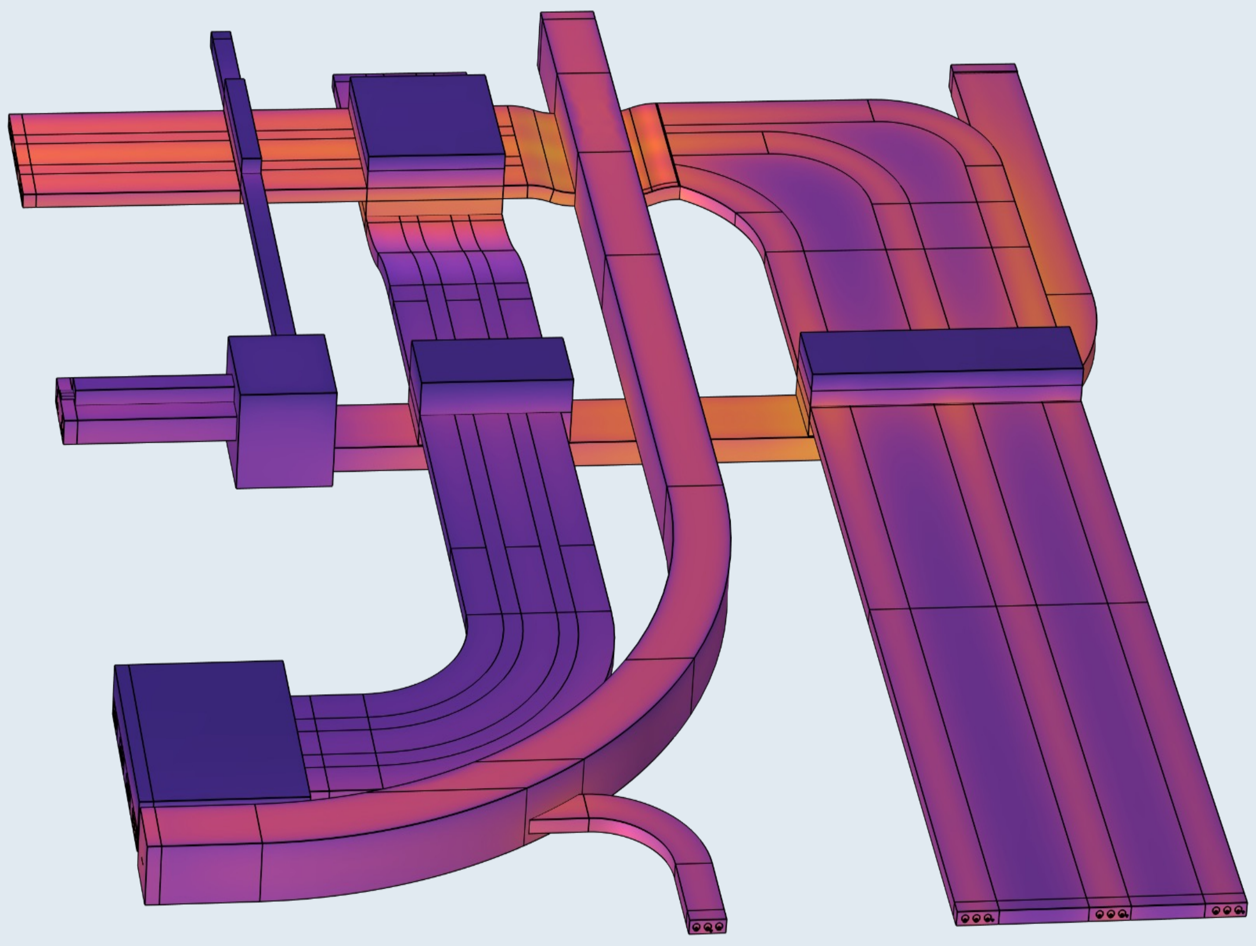

3D Thermal Analysis of Complex Cable Crossings

This work investigates the effect of multiple cable crossings on cable temperature, by introducing a modeling approach, which takes advantage of several COMSOL® features.

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Abstract

Cable crossings can affect the performance and ratings of cables, depending on the distance and angle between them. They can be sub-sea or underground and, when installed adjacently to other power cables, they are subject to higher temperatures than the expected ones, due to the thermal contribution of the other cables. This model analyses more than 20 cable crossings consisting of cables of different voltage levels installed in various depths and angles. To account for the effect of the crossings, this analysis can only be conducted in 3D. Heat transfer in Solids and Surface-to-Surface Radiation physics are solved. Effective use of COMSOL® resources is demonstrated throughout the analysis.

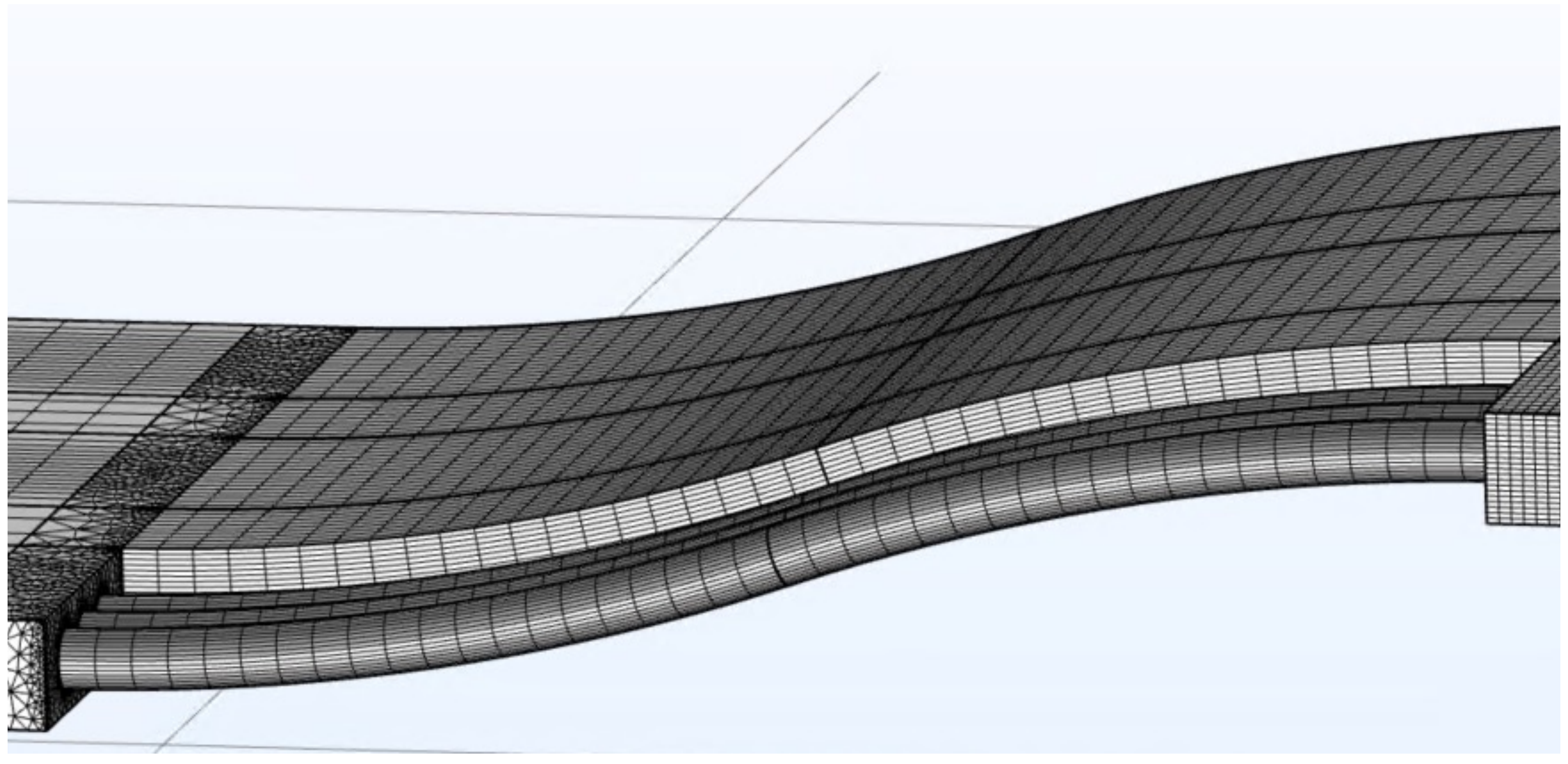

FIGURE 1. Maximum temperature at HV cables.

Methodology

The imported geometry is modified via virtual operations and sectionalised to simplify the mesh procedure. Domains with equivalent material properties are utilised to reduce the number of domains. The biggest challenge is the mesh creation. Fictitious backfills are utilized, while swept mesh is preferable compared to free tetrahedral, since this significantly reduces mesh size. Different solver configurations are examined, and the most accurate method is finally selected. The use of Selections for the application of boundary conditions is critical due to the complexity of the geometry.

Heat Transfer in Solids and Surface-to-Surface Radiation physics are solved using a direct solver with linear discretization. A better mesh quality and a smaller solver tolerance are applied to increase accuracy.

Results

The maximum temperature value observed is 89.6°C on the centre conductor of the High Voltage (HV) cables.

The temperature profile along the conductors is following the installation conditions of the cables. Peaks are observed at the crossing points or at areas where the cables are buried deeper. At critical areas, for example at crossings, lower temperature values are achieved by means of appropriate backfill material.

This modeling approach can be used for the analysis of complex 3D models, and it is applicable for a wide range of applications.

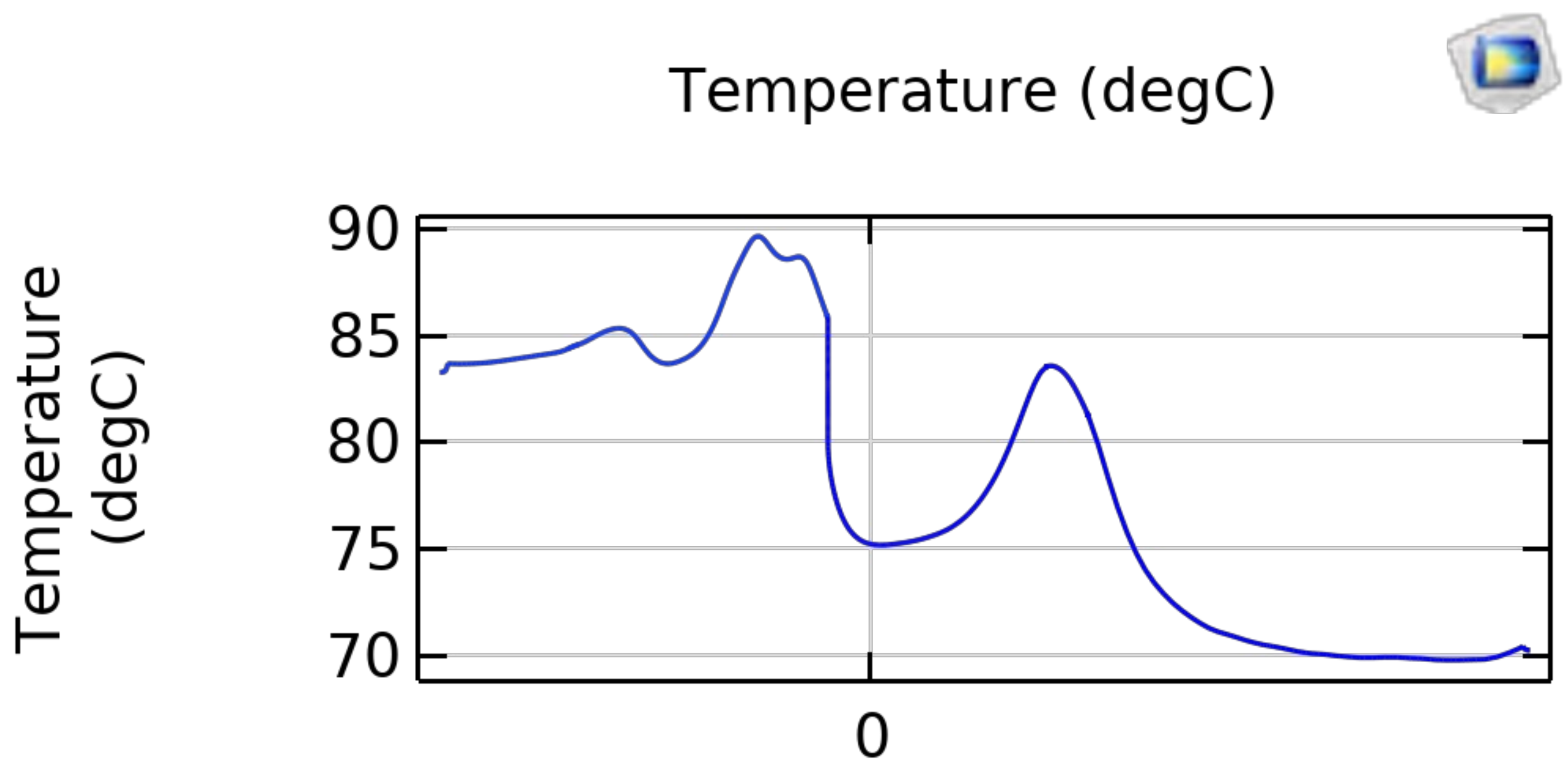

FIGURE 2. Temperature distribution along HV cables hottest phase.

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