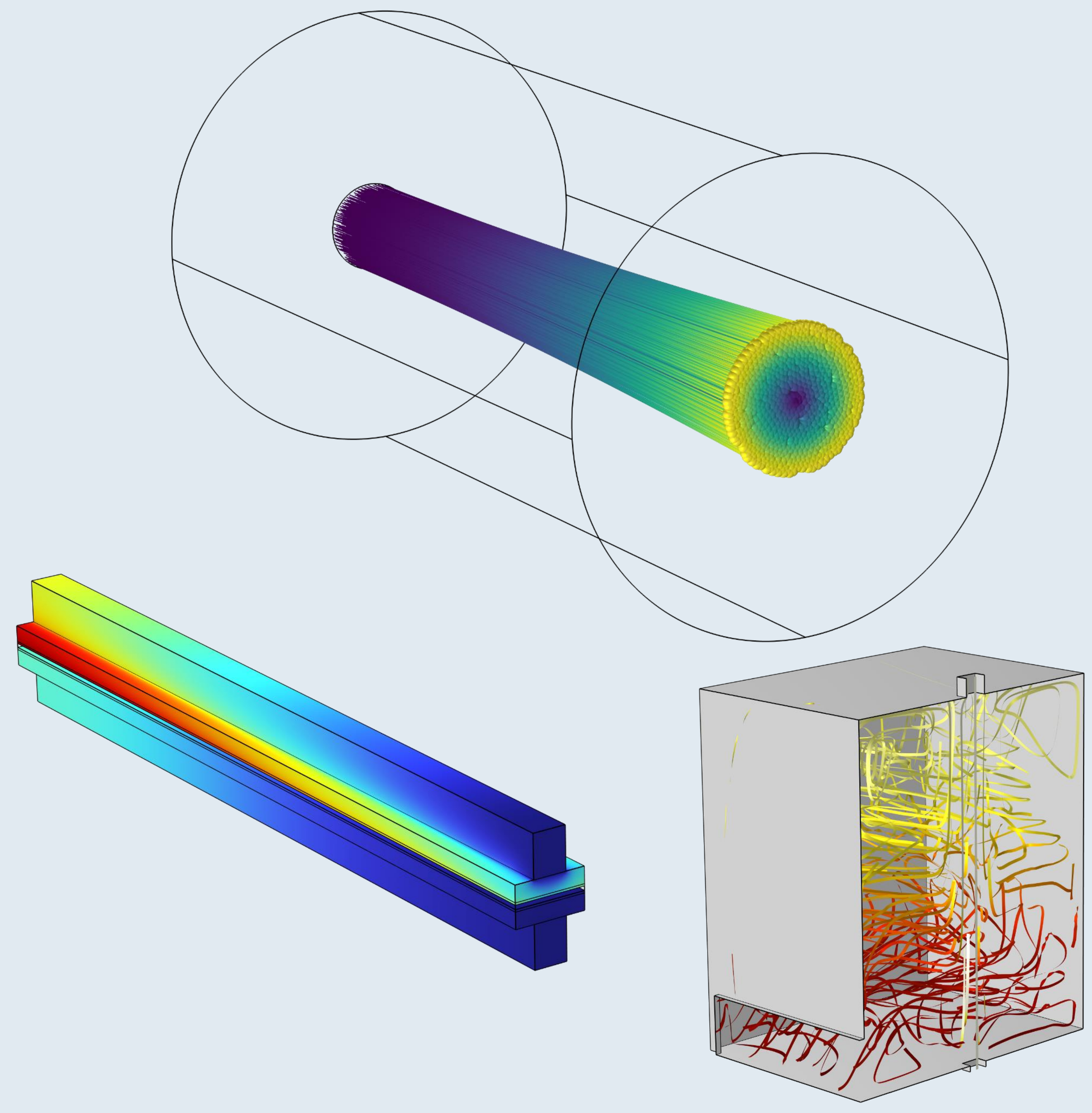

Which Hardware to Choose for the Optimal Simulation with COMSOL®?

Besides the accuracy of the results, the required computation time is an important factor for simulations in general. Thus, the question arises, which computer properties (cores, cpu frequency, platform) influence the computation time.

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Introduction & Goals

The execution of large and complex simulations is not possible on most physical computers due to a lack of resources or involves a costly upgrade. For this reason, the computations are often outsourced to virtual machines, which can be more cost-effective and allow for better resource management. In some cases, there is even a reduction in runtimes. To investigate this in more detail, benchmark tests were carried out with three different models at 9 computing machines (4 physical and 5 virtual).

From the findings of our study, we can derive recommendations for optimal hardware properties for a given set of COMSOL library models. In addition, the results can be used to optimize virtual machines for specific tasks. This benchmark can also help to choose the most suitable, cost efficient hardware for specific problems while decreasing the required computation time.

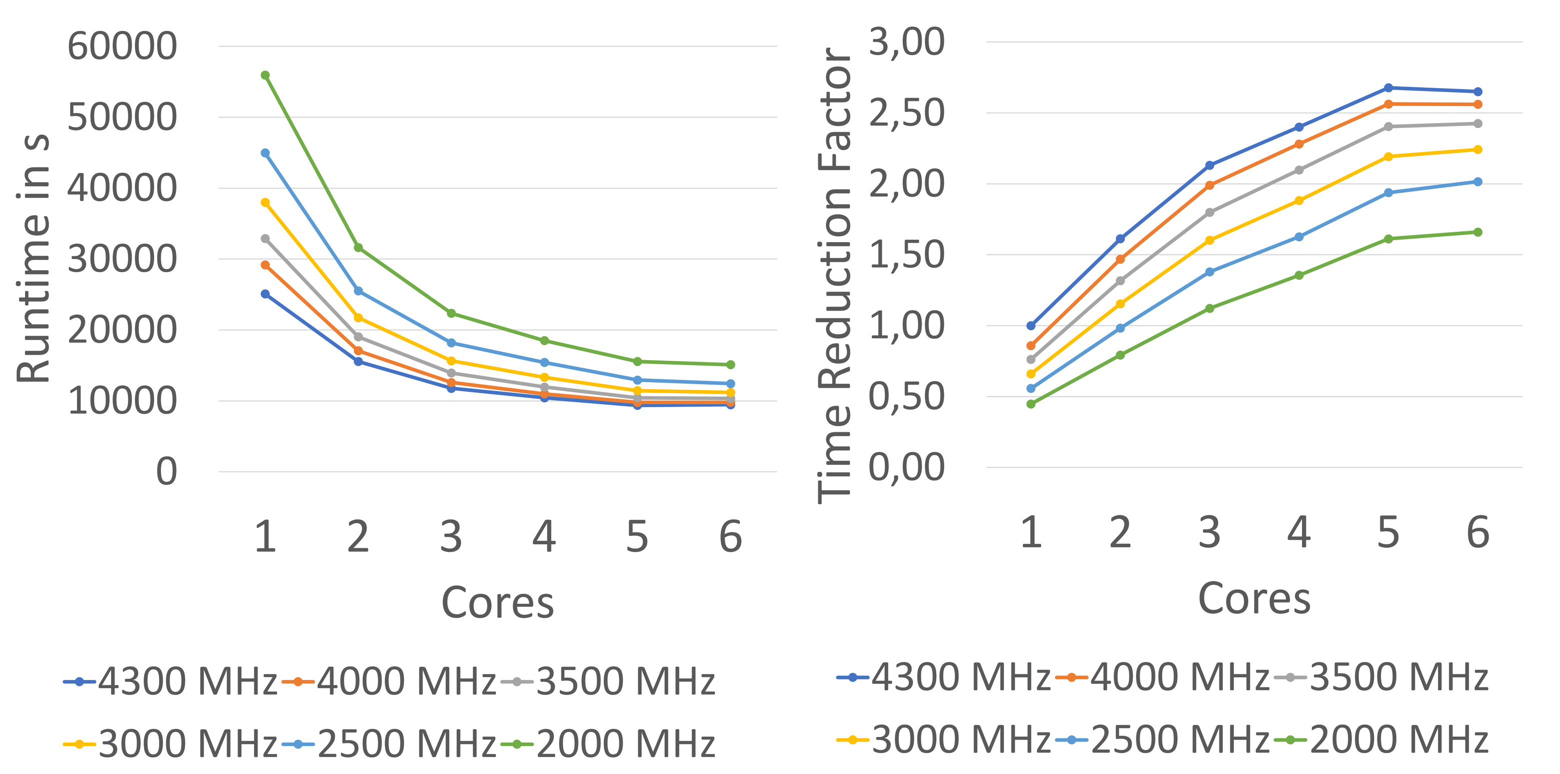

Figure 1. Left: Runtime of the model "Displacement Ventilation" for different clock frequencies and number of cores using a gaming PC. Right: Time reduction factor with highest clock frequency as reference.

Methodology

The models are chosen to cover a wide range of challenging simulation tasks. First, our benchmark test uses a model ("**E**lectron_**B**eam_**D**ivergence") where the AC/DC Module is coupled with the Particle Tracing Module to model charged particle dispersion. In the second model ("**D**isplacement_**V**entilation"), the CFD Module and the Heat Transfer Module are combined via the Nonisothermal Flow Multiphysics node. In the last model investigated ("**HT_PEM**"), the transport of reactants and water in a high temperature PEMFC is studied. In addition to the Fuel Cell and Electrolyzer Module, the CFD Module is used to model the gas flow for both the anode and cathode sides of the PEMFC. In order to obtain the most general results, different physical and virtual machines are used for the simulations.

Results

Figure 1 shows that both a higher number of cores and a higher clock frequency lead to shorter runtimes. However, the improvement in performance by increasing the number of cores is limited. Nevertheless, this knowledge can help to select a suitable machine for performing simulations.

From figure 2 it can be seen that the clusters Meggie (Ref 2), Fritz (Ref 3) and Woody (Ref 1) have significantly shorter runtimes in all three simulations than the physical computers (with the exception of AMD-Threadripper). Since the Threadripper does not count as consumer electronics, but as a computing machine designed for high performance, the acquisition costs are correspondingly high. In this case, it would be worth considering a virtual machine instead of a physical computer.

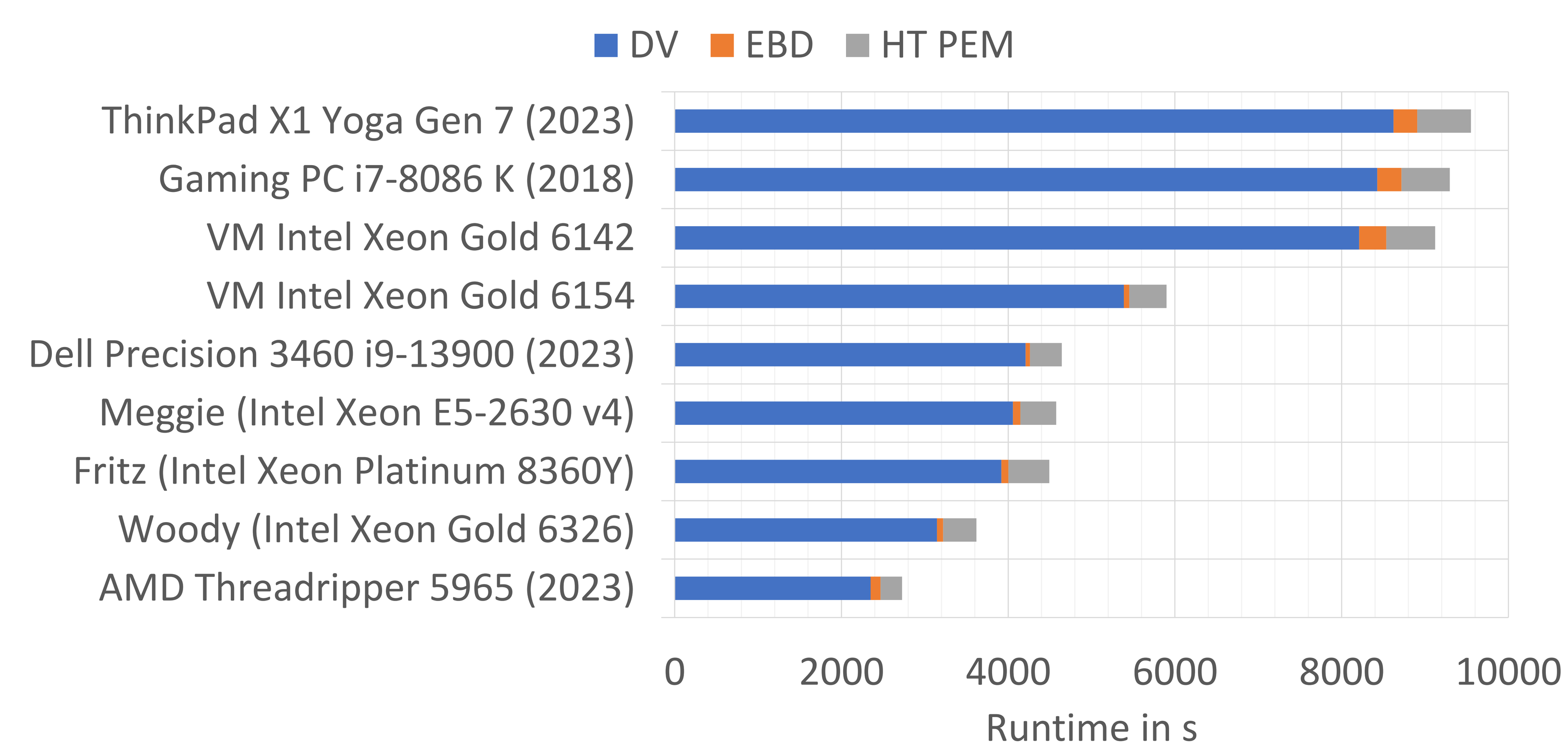

Figure 2. The bar chart shows the runtimes of the models depending on the physical and virtual computing machines used.

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