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Application of system identification methods to implement Comsol models into external simulation environments

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Introduction

Full coupling of distributed parameter models, like Comsol, with the lumped models often lead to very time-consuming simulation duration times. In order to improve the speed of the simulations, the idea of using system identification methods to implement the distributed parameters models of Comsol into external simulation environments (SimuLink), is explored. The system identification procedure will be implemented to identify a model of the thermal response of a building component belonging to a certain building that is of interest. This building is the Amstelkring Museum:
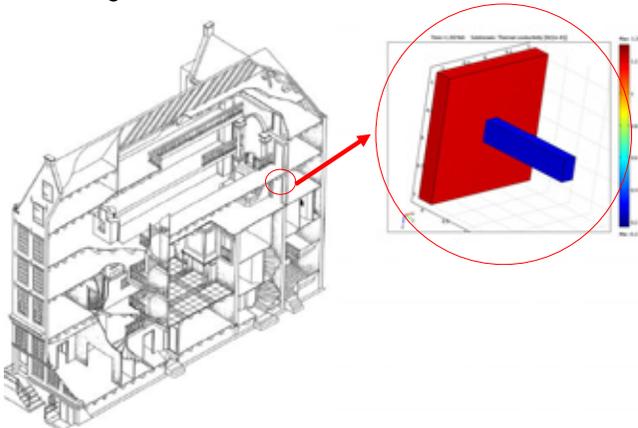
More specifically, the surface temperature at the point of the intersection of the wooden beam with the external wall (made of traditional brickwork) is chosen as one of the output signals of the model.

Comsol simulation

A 3D dynamic solution was obtained:
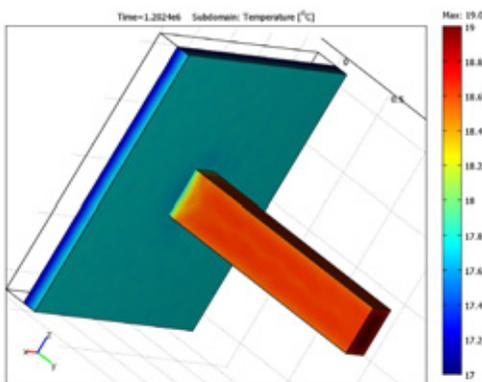
Identification and modeling in SimuLink

The MatLab System Identification Toolbox is used to produce a state-space system of the simulated heat flow and verified with the original data from Comsol:
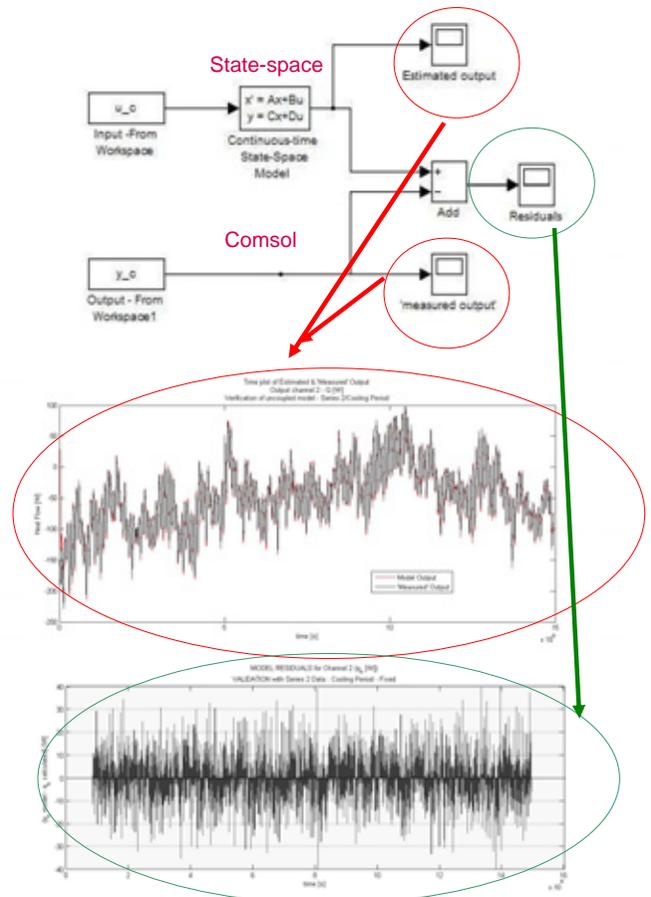
Conclusions

A system of interest belonging to a certain building was selected and a linear state-space model describing the thermal response of the system, simulated using Comsol, was identified. The model was derived using the well-known System Identification (SI) Toolbox in MatLab and was then coupled with the building's indoor climate model in the SimuLink environment we have demonstrated that the system identification methods are indeed a valuable tool for such applications, and result in models that not only are easy and fast to derive using the appropriate tools (SI Toolbox of MatLab), but also in models with a very satisfactory performance that offer great reduction of the simulation times..