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<AT>The development and validation of the linear time varying Simulink-based model for the dynamic simulation of the thermal performance of buildings

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Highlihts

- The 5R1C thermal network model of the building zone of EN ISO 13790 has been converted to state-space model.
- The Simulink model with time-varying parameters has been validated against the EnergyPlus detailed simulation.
- Presented simulation model meets the requirements of accuracy and can be practically applied.

<ABS-HEAD>Abstract

<ABS-P>Simple models used for the simulation of the thermal performance of buildings usually assume constant (time-invariant) values of their parameters. This paper presents the simple and efficient solution for the simulation of the thermal performance of the building with the time-varying parameters of its thermal network with the use of the Matlab/Simulink. The lumped parameter thermal model taken from EN ISO 13790 was used to build the simulation model in the state space. Then it was validated for two different ventilation schedules, each for 20 European cities. Reference results of the annual heating and cooling needs were taken from the EnergyPlus detailed simulation, showing satisfactory accuracy of the developed model. An error analysis of the hourly indoor air temperature prediction was also performed. For this purpose, statistical goodness-of-fit criteria were used: the Mean Square Error (MSE), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Mean Absolute of Percentage Error (MAPE) and coefficient of determination (R^2). These metrics showed a very good quality of prediction of the presented model.

<KWD>Keywords: Linear Time Varying; EN ISO 13790; Simulink; stvmgain; Thermal network;

EnergyPlus

<td:DefL>Nomenclature

A_f total conditioned area of the building, (m^2)

A_m area of the thermal mass, (m^2)

A_{tot} total area of all internal surfaces facing the building zone, (m^2)

C_m internal thermal capacity of the building, (J/K)

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