Dynamic U value measurement for building state forecast

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Numerical results show that heat flux through a construction can change by up to 10% at constant temperature difference due to moisture and temperature inside the material.

We propose using heat flux sensor data as input for neural networks to improve the forecast of the climate in buildings.

With FCNN the forecast error decreases by more than 8% when the Dynamic U value is used. However, with TCNN, using Dynamic U as well as raw heat flux measurements resulted in higher error than with just random values instead.

This can be due to inability of the network to determine when this information should be used. This motivates further research to develop an improved neural network architecture.

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Introduction

Nowadays methods, capable of independently assessing the dynamics of building climate and controlling the building management systems, are gaining popularity.

Performance of several such control strategies depends on precision of the climate forecast.

Based on numerical analysis in WUFI software of a test building in Latvia, we propose the use of heat flux sensors in combination with data post-processing (after which we obtain the Dynamic U value) to improve building climate forecast provided by neural networks. We tested fully-connected (FCNN) and temporal convolution neural network (TCN).

WUFI simulation

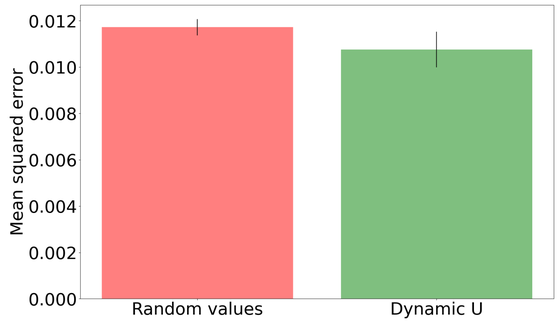
The changes in U-value of a real structure due to moisture and temperature changes were analyzed numerically in WUFI Pro.

Results of the simulations were verified by humidity and temperature measurements inside the structure.

Analysis of numerical results indicated that climate forecasts of neural networks could be improved by using heat flux measurements in addition to humidity and temperature data etc.

Tests with FCNN

At initial stage to evaluate the impact of the proposed Dynamic U method, we trained several FCNN models to obtain objective average result.



Tests with TCN

With FCNN input data length was only limited to 180 min, but with TCN it is 1 week. Since the Dynamic U value input data is a vector, it was decided to evaluate TCN models also with raw heat flux data (without post-processing).