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Data-driven approach enabling post-operation evaluation of air conditioning performance regarding thermal conditions attained indoors

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ABSTRACT

Data-driven approaches become more and more attractive in building performance analysis including performance assessment of heat, ventilation, and air conditioning (HVAC) systems. Their popularity is associated with the increasing availability of large amounts of high-quality building-related measurement data. The study is focused on a data-driven approach that enables post-operation evaluation of AC performance based on indoor air monitoring. It allows for the identification of the classifying solution which recognizes the monitoring data that is representative of thermal conditions during AC operation. The major novelty consists in proposing the classification performance criterion, which is $F1_w$-Score (the weighted F1-Score), and the procedure of weights selection. The procedure utilizes Hellinger distance (H). It is applied to measure the similarity between the binary empirical probability distribution of T and RH (EPDtr), associated with AC operation, and the prediction of this distribution (EPDes), made by the classifier. The approach was tested on three years of data from continuous indoor air monitoring in the IT engineers' room equipped with an AC unit. The best weights of $F1_w$-Score were $w_{PPV} = 0.85$ and $w_{TPR} = 0.15$. The best classifying solution was identified using $F1_w$-Score. It involved: Logistic Regression as the classifier and feature vector being Fourier spectrum of 16 min long fragments of RH and T time series. The performance of the best classifying solution was high as indicated by $F1_w$-Score $= 0.89 \pm 0.05$. The corresponding H(EPDtr, EPDes) $= 0.17 \pm 0.04$ pointed at the capability to identify the measurement data that characterizes indoor conditions during AC operation well. This work contributes to the development of data-driven approaches serving diagnostics of HVAC systems. It draws attention to the problem of defining the classification performance criterion which takes into account the ultimate, domain-specific use of the classification results.

Table of abbreviations

ANOVA	Analysis of variance
AC	Air conditioning

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