Well-being and increased productivity by user-centric pattern recognition and fault evaluation of dynamic operating complex (building-) systems

Dipl.-Ing. Christian Struck (FH), Prof. Urs-Peter Menti

Lucerne University of Applied Sciences and Arts, Centre for Integrated Building Technology, Horw

The increase of well-being and productivity of building occupants as well as the reduction of the demand of fossil energy sources are conflicting performance aspects in building design. To address this conflict it is necessary to quantify and communicate the cumulative impact of building systems and their parameters. The impact of system parameters is complex and seldom linear. The question that arises is: “Which combination of parameters best maintains occupant’s requirements on building performance, now and in future?”.

Four points have been identified to generate a basis for decision making, justifying changes to the system and its set points: (1) Comparison of simulated and measured time series data for performance aspects; (2) recognition of performance patterns; (3) identification of differences and commonalities, and (4) quantification of the parameter impacts. Traditional graphical data display formats are limited useful for the communication of the parameter impact on performance aspects as they tend to excel human capacity limits. The use of simplified data display formats however, increases the risk to decide for sub-optimal system technology and parameter values.

To identify solutions for the described problem an incremental research approach is assessed suitable. That means extending commonly used data display formats by further attributes e.g. interactivity and dynamics. The subject and the proposed approach require a multi-disciplinary research team consisting of at least three disciplines such as building technology, arts & design as well as informatics. The research questions to be answered are: (1) “What knowledge from other research fields can be applied to visualise data for decision making in building science?”; (2) “Which stakeholders need to be addressed and which standards and conventions with regard to data displays exist in their field?”; (3) “Which arithmetic operations are suitable for identification of difference-patterns of more than two system parameters?”.

The incremental research approach is based on existing knowledge and aims at pushing its expansion and application. The prototype to be developed is based on realistic case studies. Iterative research allows the application of usability engineering techniques. The following research methods should be used: (1) Literature survey; (2) iterative prototyping; (3) user testing, and (4) reporting.

It is expected that the communicability of system states should be enhanced by consciously considering human capacity limits and specifically extending the attributes of suitable data display formats. The increased understanding of the system states has the potential to lead to a better economic and ecologic performance of the overall system.