

Estimating Occupancy in Residential Context Using Bayesian Networks for Energy Management

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Abstract : A general approach is proposed to determine occupant behavior (occupancy and activity) in residential buildings and to use these estimates for improved energy management. Occupant behaviour is modelled with a Bayesian Network in an unsupervised manner. This algorithm makes use of domain knowledge gathered via questionnaires and recorded sensor data for motion detection, power, and hot water consumption as well as indoor CO₂ concentration. Two case studies are presented which show the real world applicability of estimating occupant behaviour in this way. Furthermore, experiments integrating occupancy estimation and hot water production control show that energy efficiency can be increased by roughly 5% over known optimal control techniques and more than 25% over rule-based control while maintaining the same occupant comfort standards. The efficiency gains are strongly correlated with occupant behaviour and accuracy of the occupancy estimates.

Keywords : energy, management, control, optimization, Bayesian methods, learning theory, sensor networks, knowledge modelling and knowledge based systems, artificial intelligence, buildings

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