A virtual test-bed for building Model Predictive Control developments

Raymond Sterling[1], Jesús Febres[2], Andrea Costa[3], Adeleh Mohammadi[1], Rafael E. Carrillo[4], Baptiste Schubnel[4], Yves Stauffer[4], Pietro De Cinque[3], Krzysztof Klobut[5], Marcus M. Keane[1]

[1]Department of Civil Engineering, National University of Ireland, Galway, Ireland
{raymond.sterling,adeleh.mohammadi,marcus.keane}@nuigalway.ie
[2]Fundación IK4 Tekniker, Spain, jesus.febres@tekniker.es
[3]R2M Solution SRL, Italy, {andrea.costa2, pietro.decinque}@r2msolution.com
[4]CSEM SA, PV-center, Neuchâtel, Switzerland
{rafael.carrillo,baptiste.schubnel,yves.stauffer}@csem.ch
[5] VTT Technical Research Centre of Finland, Espoo 020400, Finland Krzysztof.Klobut@vtt.fi

INDIGO[1] is a Horizon 2020 EU-funded project carried out by six partners from across Europe that aims to realise more efficient and economic planning, control and management of existing District Cooling (DC) networks. This will be achieved through two specific objectives. The first one is to widen the use of DC systems and motivate the competitiveness of European DC market by the development open-source tools for planning and modelling DC systems (del Hoyo Arce *et al.*, 2018). The second objective is to reduce primary energy consumption via improved DC system management strategies aimed at system efficiency maximisation and cost minimisation.

In this paper we present the results of the work performed to improve the energy consumption of the DC systems across several tasks of the project. This includes modelling and simulation of various buildings and the development and implementation of Model Predictive Controls (MPC) to reduce energy use in buildings.

Modelling and simulation within this paper is presented for the Building models. The geometry, materials, weather, air infiltration and internal gains of the models are developed in EnergyPlus and the model of the energy systems, focusing on the air distribution system while air handling units are built in Modelica.

The aim of the modelling was two-fold. To provide an accurate and validated test-bed for testing the behaviour of the MPC and, at the same time, generate the synthetic data used for the initial development of said controllers.

Model integration across different platforms is performed via Functional Mock-up Interfaces and this article presents the full workflow on the implementation from initial building model development to the generation of results from the MPC.

[1] www.indigo-project.eu