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Post-doc position on future-proofing heritage townhouses by optimizing comfort and energy in time and space

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Company: EnergyVille

Location: Leuven

Category: other-general

Beschrijving

At the division of Applied Mechanics and Energy Conversion (TME) of the Department of Mechanical Engineering at KU Leuven, the Thermal Systems Simulation (The SySi) Team aims to sustainably use resources through integration and optimisation of thermal systems performance in the built and industrial environment, including other energy vectors.
System integration is key.

Their scientific expertise can mainly be found in: (1) modelling and simulation: from detailed emulator and controller models to reduced models, using object oriented modelling, (2) optimisation and control: optimal design and optimal control, towards integrated optimal control and design (co-design); (3) experimental tests: from lab-scale to pilot plant and field tests to verify and validate models and methods as a proof-of-concept, also including real-life demonstrations.
Starting from domain knowledge is key.

Research topics (most of them investigated in the frame of PhD research) include among others: physics-based modelling (white-box and grey-box) - toward white-box models enriched by data (zebra-box), Model Predictive Control (MPC), Building (and District) Optimization Testing Framework (B(D)OPTEST), from building level to clusters of buildings (collective concepts)

to multi-sectorial integration, thermal networks (THERNET) for heating and cooling, flexibility through Demand Response (DR) in multi energy vector systems, including uncertainties towards robust design and robust control.

The SySi Team, led by prof. Lieve Helsen, has gained significant expertise and international recognition in the field of system integration for performance optimisation of thermal systems. White-box MPC in tertiary buildings is now commercialised through the start-up BUILTWINS. Today The SySi Team consists of 1 professor, 1 innovation manager, 1 post-doctoral researcher and 4 PhD students. In September 3 the group will be extended with 2 researchers and 1 post-doctoral researcher, and in January 4 with 3 PhD students and 2 post-doctoral researchers. The research has very close links and is integrated within EnergyVille, a research collaboration between KU Leuven, VITO, imec and UHasselt on sustainable energy and intelligent energy systems.
This post-doctoral position is (together with a PhD researcher) framed in and funded by the Horizon Europe project HeriTACE (Future-proofing heritage townhouses by optimizing comfort and energy in time and space), which is a Research and Innovation Action (in the HORIZON-CL5-3-D4-- call) set up as a collaboration between partners spread over Europe. This project aims to develop and demonstrate a holistic renovation approach for heritage buildings, accounting for the heritage value of the building and its durable and high quality preservation for the future generations, the indoor environmental quality, the overall energy-efficiency, the increased use of renewable and residual energy sources (R2ES), the overall sustainability, and cost-effectiveness. To achieve this, the renovation approach integrates and optimises solutions at three scales: the building and system components, the building and the neighbourhood.The HeriTACE project brings together a transdisciplinary team of research institutes, authorities, SMEs, and industry experienced in design, technology, and policymaking in the domains of conservation, buildings and energy. A significant increase in deep renovations of heritage buildings has the potential to lead to effective energy demand reductions and readiness for the transition to Renewable and Residual Energy Sources (R^2ES). Based on prior research and field knowledge supported by various EU and national projects, bottlenecks have been identified that prevent the futureproofing of heritage buildings and its replication. To overcome them, HeriTACE proposes innovative technical solutions, integrated into a holistic and multi-scale renovation approach, by developing and validating:

A replicable holistic assessment model and standardised processes to create a holistic vision and plan on the renovation requirements for heritage townhouses in historical neighbourhoods.

Optimal and integrated design approaches for the deep renovation of heritage townhouses.

Durable insulation and air tightness solutions for renovation of building envelopes

Optimised and smart controlled HVAC-concepts adapted to heritage townhouses

Integrated R²ES-based energy supply solutions, maximising the share of local R²ES in heritage buildings within historical neighbourhoods

The HeriTACE solutions are targeting to reach maturity of TRL4-5 by the end of the project. The project will deliver solutions for authorities and designers to envision and govern a sustainable energy future for heritage townhouses in historical neighbourhoods. The post-doctoral position defined here will focus on the integrated R²ES-based energy supply solutions, maximising the share of local R²ES in heritage buildings within historical neighbourhoods. The key innovations, tackled by the team of the post-doctoral researcher (for 1 year) and the PhD student (for 4 years), assisted by the innovation manager Dr. Glenn Reynders and supervised by Prof. Lieve Helsen, in close collaboration with Sweco Belgium and Finland, Builtwins, ZH Spinoff and UGent, will be:
(Hybrid) R2ES-based energy supply concept design for individual building and collective hybrid R2ES-based energy supply concept design for building blocks, including innovative concepts with heat recovery from unharvested local sources;

Automated fault detection using the calibrated white-box model, demonstrated on the individual building;

Extension of white-box MPC to building blocks (including novel concepts, integers, combination of short term and long term effects, scalability by distributed MPC);

Integrated optimal control and sizing of energy supply and energy storage devices, using white-box MPC, including stress-testing for robust and resilient design;

Simulation-based assessment showing the gains by the innovative concepts, the novel integrated sizing method and the integration of historical buildings in a building block;

Contribution to recommendations for context-based individual building design, multi-dimensional model for holistic and multi-scale assessment, guidance for decision making, communication and dissemination.

Profiel

We are looking for a highly motivated, enthusiastic, dynamic, mobile, well-organised and communicative senior researcher with a PhD in Engineering or a related field. The candidate has leadership skills that can be further developed in the project, and a strong background and interest in energy, and especially in (collective) thermal energy systems (for historic city centers), (optimal) control (MPC), (physics-based) modelling and optimisation, and real-life demonstrations. The post-doctoral researcher coordinates the KU Leuven work in the HeriTACE project and is active in all tasks assigned, thereby guiding the PhD student in the daily work.The candidate is expected to:

Be scientifically rigorous, initiative taking, results oriented, loyal

Be proficient in English (spoken and written) to allow effective communication, knowledge of Dutch is an asset

Be able to work independently, accurately and methodically

Knowledge of Modelica and Python is an asset

Be a team player, using the broad network offered

Be an active player in the broader team, contributing to coaching the junior researchers, attending brainstorm sessions, sharing approaches, insights and vision

Contribute to the novel research in the Horizon Europe HeriTACE project, including the coordination of the KU Leuven tasks (and thus being an important contact person for the other HeriTACE consortium members) with the related virtual and real-life demonstrations, communication, dissemination and valorisation tasks

Attend international project meetings and write project reports

Present research findings at national and international conferences

Publish research findings in international top-journals

This post-doctoral researcher will be fully funded through the Horizon Europe HeriTACE project. The research is to be performed within The SySi Team in close collaboration with the PhD researcher funded by the same project, The SySi Team members working on related topics and the HeriTACE project consortium members (7 RTOs (UGent, KU Leuven, TALTECH, SINTEF, EURAC, NIKU, POLIMI), 2 Local Authorities (City of Ghent, Muinsuskaitseamet), 1 NGO (ACE), 3 SMEs (Builtwins, ZH Spinoff, LGI Sustainable Innovation), 4 LEs (Sweco Belgium, Sweco Finland, Akret, Denys)), and in the framework of EnergyVille (). The location for this position will be Leuven (Department of Mechanical Engineering), with the demonstration site located in Ghent (Heritage Townhouse). The successful candidate will receive:
An extensive international network of universities, companies and associations to work with

Multiple benefits (health insurance, access to university infrastructure and sports facilities, etc.)

A very competitive salary, including social security

The opportunity to participate in international research collaborations and international conferences

A very inspiring research climate where each team member can learn, reflect, fail, orientate, engage, feel connected, dive deep, dream, be challenged, grow, innovate, be proud, celebrate novel results and awards in interaction with each other but always starting from own strengths

The city of Leuven, just km east of Brussels, the heart of Europe, offers a stimulating, young and multicultural working environment

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