Post-Doc and PhD positions in Energy efficient buildings

In March 2007 the EU's leaders signed up to a binding agreement to source 20% of Europe's final energy consumption needs from renewable sources by 2020. This has since become the formal EU wide renewable energies directive (2009/28/EC). Energy efficiency improvements in the heating/cooling sector will have to make a significant contribution since the demand for heating and cooling represents half (49%) of the total energy demand in Europe[1]. There has been an explosion in sensor development and implementations in the last decade within many building infrastructures ranging from domestic to high end manufacturing, however it is recognized that much of this sensor information is not utilized in an effective manner to obtain energy efficient control systems. Moreover there is a large investment cost associated with the upgrade/installation of sensor networks within buildings. Figure 1 shows the trade-off between a small and large number of sensors and the resultant cost structure.

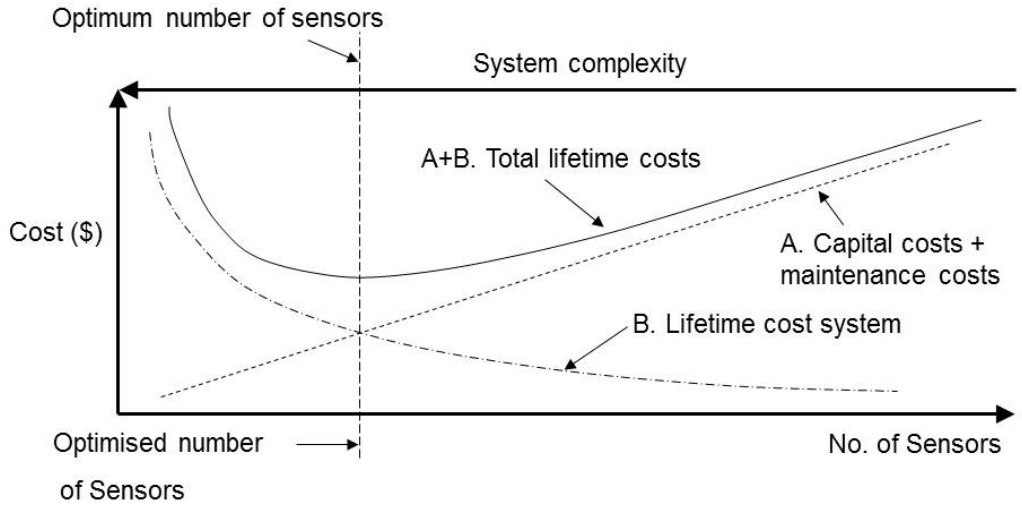

Figure 1: Lifetime cost minimisation through optimisation of trade-off between lifetime costs and number of sensors in a building of specified size.

While greater numbers of sensors should result in higher potential for efficiency gains, there is a diminishing return beyond a certain number of sensors (and type of sensors) and hence ceases to be economically viable. A key challenge of this proposal will be to link the software and sensor network to understand how the sensor/software and facilities interact and thereby provide best practices on instrumentation quantity and quality for management of energy use in a variety of building environments

Specifically the project will address
1) Develop an abstracted building-block representation of energy flow within a building;
2) Develop modeling approach to predict energy flow within the building for the above building blocks;
3) Identify best practices to instrument data for one-time as well as ongoing data collection, with a focus on minimum install costs and maximum long term gains

[1] (2009). 2009 Technology Map of the European Strategic Energy Technology Plan. European Commission, JRC-SETIS Work Group.

4) Determine the lowest number of sensors per unit volume and smallest number of measured parameters to be measured, and accuracy of the measured parameters, etc);
5) Demonstrate approach in up to 3 different types of building environments, e.g. i) office building; ii) mfg facility; iii) IT operational facilities.

The project can be divided into three phases.
PHASE 1. Literature review of existing state of the art and Preliminary Assessment - 12 months
Expected Output: Thermodynamic model identification and build for different building environments.
PHASE 2. Model Expansion and Selection of Experimental Facility. – 12 months
Expected Output: Parametric study of different building environments and sensor network topologies, software package for environments, and plan for experimental validation.
PHASE 3. Model Validation and Demonstration – 12 months
Expected Output: Experimental verification of model within data center environment.

Model development techniques/sensor acquisition will be utilized through Matlab/Labview to provide a universal platform for ease of collaboration. For the experimental phase training and implementation of specialized equipment including state of the art techniques of thermography and high speed single camera and stereo PIV systems, will be made available to the IRCSET student along with training. Travel and presentation at leading fluid mechanics conferences and short term visits (1-2 months) to the COOL team in HP will also form a core part of the PhD program. These events are in addition to the graduate schools year round events for the PhD community. This proposal has jointly originated through a three year collaboration between Stokes Institute, University of Limerick and HP California. The proposal provides the successful candidate with an excellent opportunity to work with the leaders in the field in an industrial research environment.

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