Empowered by: KU Leuven, VITO, imec & UHasselt

IAMHEX Team
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Leuven, June 30th, 2021

Subject: Participation in the advisory committee of the project Advanced heat exchanger design and optimization with innovative additive manufacturing

Dear,

By this Letter, we would like to gather your interest in the research activities and the project, which we will propose for the VLAIO cluster Strategic Basic Research (cSBO), concerning the design and optimization of next generation compact heat exchangers.

In this project we bring together emerging methods and methodologies in manufacturing, design and experiment based upon available expertise in our research groups at KU Leuven and VITO to drastically improve the overall energy efficiency (reduced pressure drop and increased effectiveness), and material use in compact heat exchangers. This becomes more and more crucial to meet future demands for cost-effective distributed energy systems and light-weight mobile components.

Current design methods are often based on trial-and-error and combine simplified heuristic heat exchanger models with experimental calibration to obtain specific designs that are verified in a very limited range of test conditions only. The huge increase in manufacturing flexibility that comes with 3D printing enables a new generation of heat exchangers which overcome the limitations of present designs. To fully exploit these new opportunities, novel design methodologies at the forefront of what is presently available in numerical software are crucial.

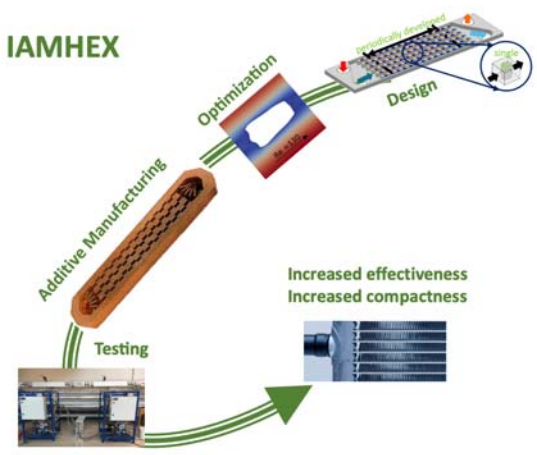
Such a new generation of simulation-based design methods has been developed at KULeuven's Thermal and Fluids Engineering group headed by Prof. Tine Baelmans in collaboration with VITO's Thermal Energy Systems group. It combines advanced heat transfer modelling with optimal design techniques to realize automated design at a reasonable computational cost. In this research, we have shown that these methods are capable of optimizing both the detailed shape of fins or even the complete lay-out of heat sinks and other thermal devices to maximize their performance. Preliminary results indicate that, for heat exchangers, **design improvements of 15 to 30%** are achievable in terms of reduced energy consumption for the same thermal performance. However, because of the high degree of freedom in the design, the

manufacturability of the resulting shapes and lay-outs are often questionable. Therefore, this project aims at elaborating the automated design of heat exchangers (HEX) with innovative three-dimensional heat transfer surfaces, while ensuring their manufacturability from the start.

It is clear that the manufacturing of such novel optimized HEX designs requires advanced additive manufacturing processes (AM). Unfortunately, 3D printing of highly conductive metals like copper and aluminium alloys poses at present still some research challenges. In addition, the surface quality and resolution of standard 3D printing techniques hampers their application for the design of compact heat exchangers. With their recent innovations in the field of additive manufacturing based on copper and aluminum materials, the research groups of prof. Brecht Van Hooreweder at KU Leuven and dr. Marleen Rombouts at VITO aim to bridge this gap in the near future. Moreover, with the support of prof. Rosaria Vetrano, who is a leading expert in advanced measurement techniques, the technological potential of these innovative HEX designs can also be assessed experimentally.

In light of these recent developments at KU Leuven and VITO, the IAMHEX project is launched, as a multidisciplinary approach to increase the overall energy efficiency, and lower material usage of heat exchangers as this will drastically reduce the total cost of ownership of heat exchangers. Concretely we will:

- Develop advanced design software that optimizes both the complete fin shape and other heat exchanger parameters to achieve highly performant heat exchangers that can directly be manufactured using 3D printing.
- Extend advanced additive manufacturing techniques to allow for 3D printing of metals with high thermal conductivity (aluminium and copper alloys), with high design freedom and good material and geometrical properties (surface roughness, resolution, accuracy).
- Assess experimentally the performance increase of the optimal configurations on real-scale prototypes.



Having in view your expertise and activities, we would like to invite you to be part of the Advisory Committee of this project. As part of the advisory committee you

- obtain first insights in the research agenda, the progress of the research trajectories and all the project results;
- may be considered as first option to participate in the next-step cooperation research and innovation projects focusing on more specific applications on demand of companies (eg. Icon projects);

- gather knowledge and insights to improve own design methods and own additive manufacturing systems;
- are in contact with other industrial companies in the advisory committee;
- participate in advising the research activities while remaining within the constraints imposed by the project definition and grant conditions.

Conditions

- Write a Letter of Support to this proposal
- Participate in the advisory committee meetings of the project (every 6 months)
- The financial contribution for participation to the advisory committee is related to which spearhead cluster your field of interest mostly corresponds to.
    - Energy: Flux50
        - A Flux50 membership is not required.
        - Participation fee to the advisory committee of IAMHEX
            - 250 euro/year for SMEs
            - 1000 euro/year for larger companies
            - Valorisation members have the opportunity to provide the participation fee in cash or in kind. Talent members are allowed to provide an in kind contribution alongside the cash contribution. Non-members are limited to the cash contribution. See for more info on membership: https://flux50.com/about/join-flux50-asmember
    - Material development: SIM
        - Membership of SIM during the period of the project is necessary
            - membership fee of 750 euro/year for SMEs
            - membership fee of 3000 euro/year for larger companies
            - see also for updates and more info: https://www.sim-flanders.be/membership

Looking forward to your response

The IAMHEX team;

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