Development of Next-Generation Heat Exchangers for Oscillatory Flow Systems

EPSRC funded PhD studentship with full fee waiver and £21,805 pa stipend (2026/27 rate

Project Code: DLA_DTP_2026_07

Main Supervisor: Dr Ahmed Hamood

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Project Introduction

This project aims to develop advanced heat exchangers with enhanced heat transfer capacity and reduced pressure drop, specifically tailored for oscillatory flow in thermoacoustic systems. Current heat exchanger designs are ineffective under such flow conditions, creating a major barrier to the commercial viability of thermoacoustics for sustainable energy applications. Using a combination of additive manufacturing, computational fluid dynamics, and experimental testing, this research will produce optimized geometries that address these challenges directly. By overcoming this limitation, the project supports the broader goal of enabling clean, maintenance-free energy technologies.

Project Details

Thermoacoustic systems, which convert thermal energy into acoustic power, or vice versa, without any moving parts, are increasingly recognised as a promising solution for sustainable, low-maintenance energy conversion. Despite their potential, the development and commercialisation of thermoacoustic systems remain constrained by several interrelated technical challenges. These include the need for effective and affordable acoustic drivers, robust system integration, system size and, critically, the development of heat exchangers capable of operating under oscillatory flow conditions. Among these, heat exchanger performance has emerged as one of the most significant barriers to system efficiency and scalability.

Conventional heat exchangers, designed for steady, unidirectional flows, are not well suited to the time-dependent, reversing flow characteristic of thermoacoustics. As a result, they tend to deliver limited heat transfer and introduce excessive pressure drop. This mismatch in performance directly affects the thermal efficiency and practical viability of thermoacoustic devices in real-world energy applications.

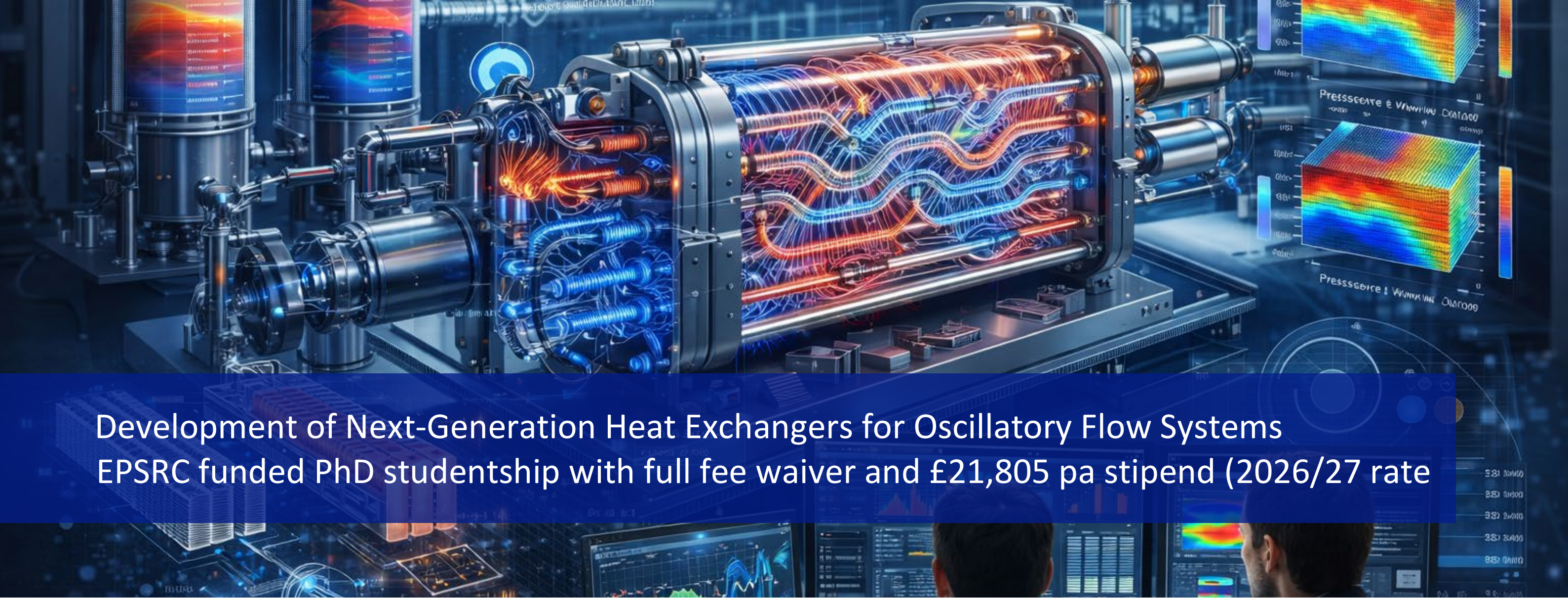
This project focuses on solving this key limitation by developing advanced heat exchanger geometries specifically tailored for oscillatory flow environments. The aim is to achieve high heat transfer capacity with minimal pressure drop, providing a critical step toward unlocking the commercial potential of thermoacoustic systems.

Metal-based additive manufacturing (AM) will be central to the approach, enabling the creation of highly complex and precise internal geometries that are otherwise unachievable through conventional fabrication methods. These custom-designed channels will be engineered with characteristic dimensions in the range of one to two thermal penetration depths, a proven design parameter for enhancing oscillatory heat transfer. The geometries will be optimised to promote high thermal contact while reducing resistance to flow.

Computational fluid dynamics (CFD) will be used to simulate oscillatory fluid flow and thermal behaviour within the proposed designs. These simulations will assess both heat transfer and pressure drop performance, guiding design iterations before fabrication. The optimisation process will ensure the most promising configurations are identified efficiently.

Experimental validation will be carried out using an existing, custom-built test rig operating with helium as the working fluid. The system will be used to measure key performance indicators, including heat transfer rate and pressure drop, under controlled oscillatory flow conditions. These results will be used to verify and refine the simulation models.

By addressing one of the central challenges limiting the commercialisation of thermoacoustic technologies, the outcome of the project will contribute directly to the development of clean, scalable energy systems supported by advanced thermal-fluid and manufacturing innovations.



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Project-specific entry requirements

Qualifications:

- Applicants should hold, or be expected to achieve, a first-class or upper second-class honours degree (or international equivalent) in Mechanical Engineering, Aerospace Engineering, Chemical Engineering, Materials Science, Applied Physics, or a closely related discipline. A relevant master's degree is desirable but not essential.

Skills and Experience:

- Strong foundation in thermodynamics, heat transfer, and fluid dynamics
- Experience or familiarity with computational fluid dynamics (CFD) software (e.g., ANSYS Fluent, OpenFOAM, or similar) is advantageous
- Basic knowledge of additive manufacturing processes or design for manufacture
- Prior involvement in experimental work or laboratory-based thermal-fluid testing is advantageous

Knowledge and Attributes:

- Understanding of the principles of oscillatory or unsteady flows is beneficial
- Motivation to engage in multidisciplinary research combining simulation, experimentation, and advanced manufacturing
- Strong analytical and problem-solving skills
- Good written and verbal communication skills, including the ability to document research clearly and contribute to publications

Further Information

This call is open to **UK Applicants only**.

Applicants should be of outstanding quality and exceptionally motivated.

The studentships are funded for 3 years (subject to satisfactory annual performance and progression review) and will provide for tuition fees and a tax-free stipend paid monthly.

Please note that there are more projects than funded studentships available and therefore this is a competitive application process which will include an interview.

Shortlisted candidates will be contacted for an interview in person or via Teams. After interview the most outstanding applicants will be offered a studentship.

Queries about the application process are welcome and should be emailed to pgrscholarships@hud.ac.uk.

Informal enquiries about this project should be directed to Dr Ahmed Hamood

Type of Award: Doctor of Philosophy (PhD).

Eligibility: UK applicants only. First Class or Upper Second-Class Honours degree or equivalent in a relevant subject area, please refer to the entry requirements on the specific projects being advertised.

Location: Huddersfield.

Funding: 3 years full time research covering tuition fees and a tax-free bursary (stipend) starting at £21,805 for 2026/27 and increasing in line with the EPSRC guidelines for the subsequent years. Funded via the Engineering and Physical Sciences Research Council Doctoral Training Programme.

Duration: 3 years full-time plus 12 months writing up (please note no funding available for writing up period).

Closing date: 28th April 2026

Start date: 1st October 2026

Application details

- Go to the EPSRC webpage and download the Expression of Interest Form 2026.
- Provide copies of transcripts & certificates of all relevant academic and professional qualifications.
- Provide references from two individuals – please contact your referees and ask them to send them directly to pgrscholarships@hud.ac.uk from their email address.
- Proof of eligibility – e.g. scan of passport photo page.
- Completed forms, including all relevant documents should be submitted via-email to pgrscholarships@hud.ac.uk.

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