IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Multi-objective Pinch Analysis for Solar Thermal Integrated Industrial Processes**	
Project Number	**IMURA0869**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address?
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*
2	***Energy, Green Chem, Chemistry, Catalysis, Reaction Eng***
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	***Clean Energy***
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

Define the problem

A large number of industrial processes demand thermal energy in the low to medium temperature range. In this temperature range, solar thermal systems have an enormous scope of application. Integration of solar thermal system with an industrial process can help in achieving green, lean, and sustainable manufacturing potential of the industry. However, to maintain market competitiveness, it is crucial to integrate a solar thermal system with an existing process in a cost-effective way. The challenge lies in the integration of a periodic, dilute and variable solar input into an existing industrial process. In this context, Pinch Analysis has the great potential to achieve the said objective.

Pinch Analysis was initially developed based on the thermodynamic principles associated with heat transfer and the flow of energy from a higher temperature to a lower temperature. The development of pinch analysis led to an entirely new approach to process synthesis based on three stages: targeting, design and optimisation. Overall optimization of the system depends on optimal selection of the minimum approach temperature for the thermal integration, selection of solar collectors, working fluid through the solar system, and sizing of other components.

Project aims

Define the aims of the project

In this PhD project, methodologies for appropriate integration of the solar system with wide verities of industrial processes will be investigated. This work aims to develop generic methodologies for appropriate integration of these systems. Economic, technical, as well as the sustainability of the overall system integration will be studied. Trade-offs between these objectives will lead to a multiple objective Pinch Analysis of the overall system and will be presented through a Pareto Optimal Front.

Expected outcomes

Highlight the expected outcomes of the project including likelihood of patents

The expected outcomes of the project will include:

1. Development of multi-objective Pinch Analysis
2. Techno-economic study of solar thermal integrated industrial processes
3. Sustainability analysis of integration of solar thermal energy system with industrial processes

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

Working with renewable energy for industrial process heat and combining the principles of pinch analysis as well as process modelling and optimization, the project will address the Goals of the ***Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*** theme.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

1. Degree in Chemical or Mechanical Engineering with good understanding of thermodynamics
3. Process modelling and optimization (preferable)
4. Excellent writing skills and ability to synthesise ideas from literature review and global

developments quickly into an executable form

5. Hard working and remaining focussed at all times while at both campuses

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Discussed and agreed by both of us.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Energy; Energy Storage; Renewable Energy; Modelling and Simulation