Stirling engines are a type of closed cycle heat engine that are able to extract power from a cyclic pressure change that is produced from the heating and cooling of a working fluid caused by a temperature difference between a thermal source and sink. Stirling engines also make use of a regenerator that work as both an internal thermal storage device and an internal heat exchanger, that can increase performance.

Performance Evaluation of a 3D Printed Low Temperature Difference and Source Gamma Type Stirling Engine
Calynn Stumpf ¹ and David S. Nobes¹

AIMS AND OBJECTIVES
Develop a gamma Stirling engine with a modular design that included:
- Modular Heat exchangers
- Modular Regenerator
- Power Piston with:
  - Adjustable stroke
  - Adjustable phase angle
Performance test developed engine

Vertex 3D Printing of Gamma Stirling Engine  (95°C) Thermal Source
Mechanical Device (Stirling Engine)
Usable Power

Thermal Sink (2°C)

DESIGN AND RESULTS

Ideal Stirling Engine Cycle

Pressure

Volume

1 → 2 Expansion
2 → 3 Heat Rejection
3 → 4 Compression
4 → 1 Heat Addition

Gamma Stirling Engine

Experimental Setup

Experimental Pressure Volume Diagram

FUTURE DIRECTIONS
- Determine maximum engine performance by finding optimal: swept volume ratio, phase angle
- Compare steady state heat transfer correlation to a transient cycle
- Predict engine performance for larger scales

PARTNERS
- Alberta Innovates
- Terrapin Geothermics Inc.

FES PROJECT OVERVIEW
This Future Energy Systems (FES) project is part of the Geothermal Theme, entitled Optimizing Geothermal Energy Production and Utilization Technology (FES T05_P03)
With the vast amount of energy available in geothermal reservoirs identified throughout Alberta, a new technology is need to access and convert this low grade heat into a useful form. This means converting available fluid temperatures, typically <100 °C into electricity or space heating. This project focuses primarily on the development of proof-of-concept and viability studies of ultra-low maximum temperature (ULTmax) Stirling engines, their design and the development of predictive models for system scale up and development.

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