AdVECT: Additive Vehicle-Embedded Cooling Technologies

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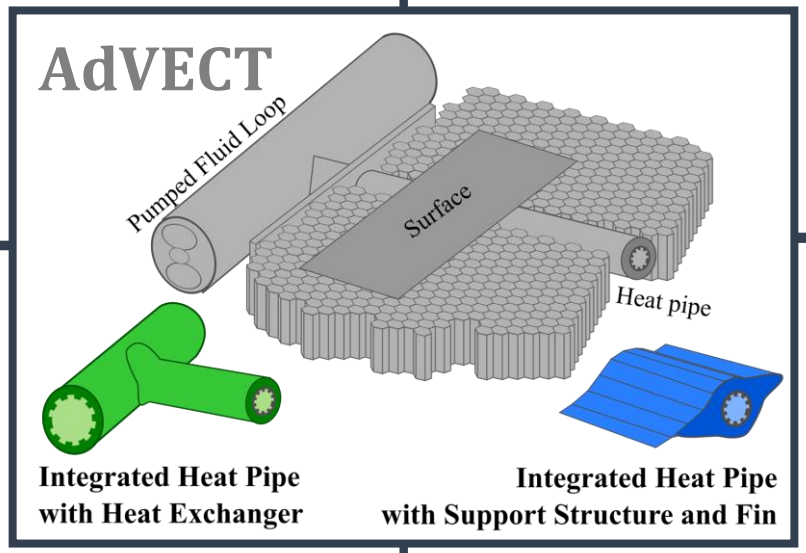
Research Objectives

Goal of this research program

- Use **additive manufacturing** and **advanced materials** to develop **low mass (<2 kg/m^2), high temp (>300°C) heat rejection systems**

Innovation and Advancement of the State-of-the-Art

- Porous ceramic radiators with **embedded heat piping**
- AM allows for **novel form factors** and **topology optimization**
- Iterative design enables rapid testing and refinement



TRL Levels

Initial: Additively manufactured, fully-embedded high temp heat rejection is **TRL 1**.

Upon Completion: Prototypes will be developed and validated (**TRL 3**).

Approach

We will use **additive manufacturing** and **novel materials** to drastically reduce the areal density of heat rejection systems. We will use **a mix of proto-typing, experimental, and analytical tools** to design and demonstrate performance.

Research Step	Outcome
Develop new ceramic resins	*High thermal conductivity material*
Parametric study of printing and sintering techniques	*Manufacturing technique for robust material properties*
Performance testing	*Demonstrate heat transport*

Potential Impact

Benefits to…

Space Science and Exploration

- Enabling technology for nuclear power sources for lunar and orbital applications
- Embedded, single-material approach is extensible to on-orbit manufacturing and thereby very large structures
- Low specific weight (kg/kW) reduces cost and enables faster transit times of critical space power infrastructure

"Spin-off" Technologies

- Extensible to other high-temperature heat rejection applications such as orbital re-entry, aerobraking, solar probes, directed energy