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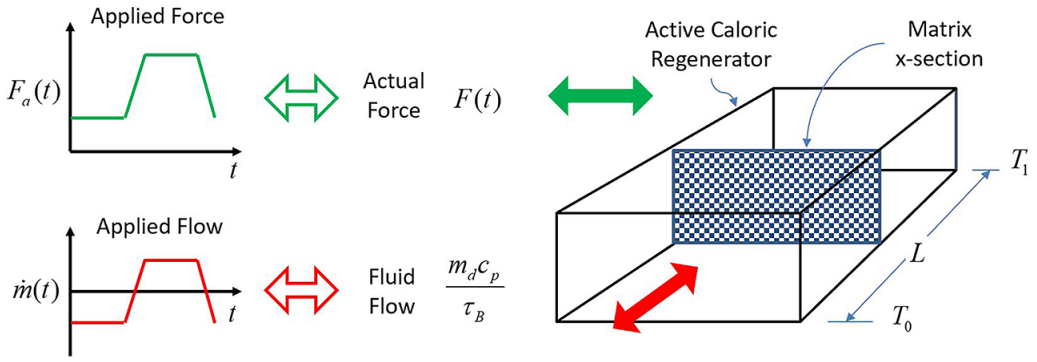
A simplified model for calculating the thermal effectiveness of active caloric regenerators can help screen caloric materials and improve future designs.



An active caloric regenerators (ACR) is a device used to create heat pumps or heat engines based on an active regenerator cycle. A key part of achieving an efficient active regenerator cycle is identifying the best caloric material to use based on specific ACR designs.

Andrew Rowe presents a simple model to determine the thermal effectiveness of an ACR operating as a heat pump or engine. Rowe believes that although complex models can offer specific solutions, they aren't as useful for building a fundamental understanding of the key physical processes.

"Complicated models can become black boxes. You can probe very specific things and get clarity but when you're looking at a design problem, things are very open ended and there are so many parameters to consider. A simplified framework can lead to a deeper understanding," said Rowe.

His model defines the thermal effectiveness of ACR as an analytic function that includes the operating, design and material parameters. In the ideal case, an array of distributed or cascaded cycles in a single structure between hot and cold reservoirs has an efficiency equivalent to the Carnot limit. In practice, however, the efficiency is lower due to non-linear material properties, finite rates of heat transfer, and regenerator design.

"I've always been impressed by how simple models can be so revealing," said Rowe. "To successfully transition caloric materials to technological devices we need to have tools non-experts can use, to help people make use of these materials."

The metrics chosen in this model are expected to help designers, innovators and companies quickly screen different caloric materials before undertaking a full, complex, expensive analysis.

Source: "Thermal effectiveness of active caloric regenerators," by A. Rowe, *Journal of Applied Physics* (2020). The article can be accessed at https://doi.org/10.1063/5.0003531.