Improving Energy Efficiency by Developing Components for Distributed Cooling and Heating Based on Thermal Comfort Modeling

Ed Gundlach
GM R&D Center
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Project ID #
ace_48_gundlach

Overview

Timeline

- Start date – May 2009
- End date – May 2012
- Percent complete – 0%

Barriers & Targets

- Early stage of development for thermoelectric devices in automotive HVAC applications
- Coefficient of performance > 1.3 to cool and > 2.3 to heat
- Reduce HVAC energy by 1/3

Budget

- Total project funding: ~$5.050M
  - DOE share: ~$2.525M
  - Contractor share: ~$2.525M
- Funding received in FY08 & FY09: $0 (thru Apr. 2009)

Partners

- Interactions / collaborations
  - *University of California – Berkeley:* Thermal Comfort testing & modeling
  - *Delphi Thermal Systems:* HVAC component development
  - *University of Nevada – Las Vegas*: Thermoelectric Materials Research
- Project lead – *General Motors*

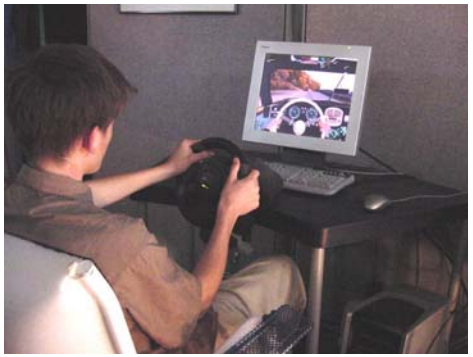
Overall Objectives

- **Develop distributed HVAC components to supplement the central HVAC system to reduce the energy required by current compressed gas air conditioners by at least one-third**
- **Develop TE HVAC components that have a coefficient of performance > 1.3 for cooling and > 2.3 for heating**
- **Integrate & test in 5-passenger demonstration vehicle**
- **Develop new thermoelectric materials to improve the efficiency of thermoelectric generators for engine waste heat recovery**

Milestones

- **Identify initial set of locations for distributed heating / cooling – September 30, 2009**

Examples of thermal comfort testing (UC-Berkeley)

Approach

- Develop Thermal Comfort model of human responses to potential locations for distributed heating & cooling
- Use Thermal Comfort model to identify an optimal combination of distributed HVAC components (including location and size of thermoelectric units)
- Develop new thermoelectric HVAC components to supplement a downsized central HVAC system
- Integrate & test in 5-passenger demonstration vehicle

Technical Accomplishments

Not applicable – Project starts in May 2009

Future Work

Work thru FY2010 includes the following Phase I activities:

- **Human subject testing to characterize the response to localized heating and cooling of body segments**
- **Expand the existing UC-Berkeley Thermal Comfort model to include potential locations for distributed heating and cooling**
- **Define and perform a Design of Experiments to validate the UC-Berkeley Thermal Comfort model**

Milestones during this period include the following:

- **Definition of Design of Experiments Completed**
- **Build Mule Vehicle for Thermal Comfort Evaluation Completed**
- **UC-Berkeley Thermal Comfort model update released**
- **Identify final set of locations for distributed heating / cooling**

Summary

- This project provides a demonstration of the savings possible from a distributed HVAC system that utilizes thermoelectric components
- By developing a Thermal Comfort model of human responses to potential locations for distributed heating & cooling units, the team is able to optimize the specification of distributed HVAC components