Master Thesis work

Heat Exchangers for Future Heavy Commercial Vehicle Powertrains with reduced CO_2 emissions

>>> heavy duty truck engines, Rankine cycles, heat exchangers, fuel savings, …

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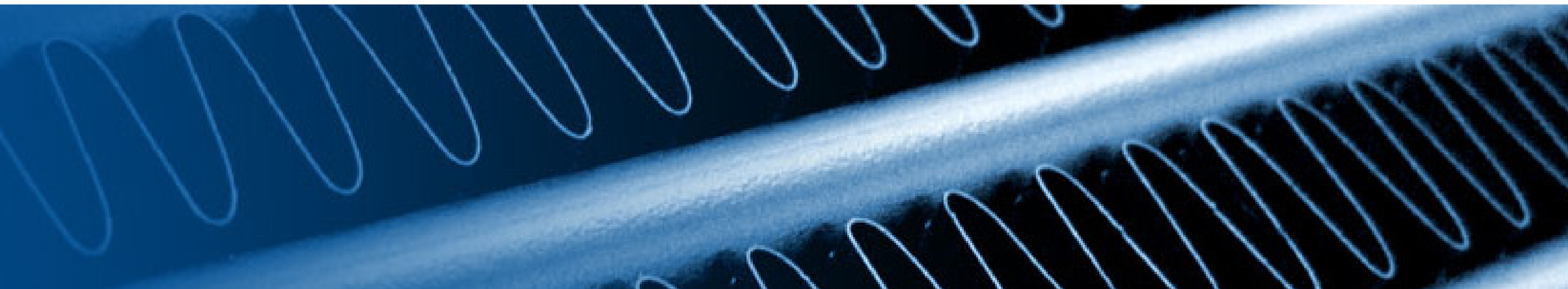

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Heat Exchangers for Future Heavy Commercial Vehicle Powertrains with reduced CO2 emissions

The commercial vehicles (CV) have for a long time used diesel engines for best economy and they have little potential in significant short term efficiency leaps. This has increased the interest for recovering energy that is cooled off or expelled in the engine exhausts. Waste Heat Recovery (WHR), bottoming cycles similar as used in power plants, will perhaps be the solution in CV applications as well. Several types of bottoming cycles are possible, from simple steam process (Rankine cycle), to advanced Stirling engines or through thermoelectric devices with batteries and electric engines.

The proposed thesis work has the objective to study a Rankine cycle WHR system, specifically the operating conditions for heat exchanger components in such bottoming cycle, in a Euro VI long haulage truck application.

Milestones:

Literature survey on bottoming cycles. The aim is to find basic information on selection on working media, expanders, basic heat exchanger types and selection – especially for low temperature Rankine (bottoming) cycles suitable for mobile applications.

Build (or modify existing-) engine- and Rankine bottoming cycle models. The aim is to get thermodynamic- and engine modeling experience and to investigate ways to implement models for bottoming cycles and detailed heat exchanger models. The cycle's simulation work will be made in GT-Power, detailed models will be made in other software's (e.g. Fortran) and linked to GT-power.

Use the models to extract heat exchanger dimensioning data and CO2 savings. The aim is to set an initial design and extract steady state temperatures and pressures for some interesting load cases, but also to find transient load data useful for design and dimensioning of heat exchangers in mobile applications. The aim is also to predict overall cycle gain in terms of CO2 savings.

Use the dimensioning data to specify heat exchanger design and materials. The aim is to refine the initial heat exchanger design and to refine heat exchanger models to get more accurate operating conditions and hence new dimensioning data. If required, the aim is also to identify limitations in the bottoming cycle components that have the greatest limitation of overall CO2 savings.

Use the models to find out how sensitive the savings are to transients and parametric variations. The aim is to find out how the savings may be affected by thermal inertia and to find out how to select performance of the bottoming cycles with respect to the engine driving cycle.

Write a final report. The aim is to have a detailed report describing all the actions that have been performed and the knowledge gained, i.e. the report should be detailed enough for reproducing the work done for reaching the same conclusions. It should also include problems faced, recommendations for improvements and future work.