CO2NTROL

Integrated solutions for noise and vibration control in vehicles

Funding: European (7th RTD Framework Programme)
Duration: Sep 2009 - Dec 2012
Status: Complete with results
Total project cost: €4,726,792
EU contribution: €2,799,391

Call for proposal: FP7-SST-2008-RTD-1
CORDIS RCN: 92595

Background & policy context:
Exploiting the potential of integrated solutions for the control of noise and vibration in vehicles to improve vehicle fuel efficiency and reduce their impact on the environment is the principal aim of this project. Today's cars represent a complex compromise between contradictory requirements with regard to safety, exhaust emissions, noise, performance and price. However, since the quality of life, particularly in the urban environment, is heavily influenced by air and noise pollution resulting from road traffic, one of the top priorities for car manufacturers is the reduction of noise and emissions from vehicles, with particular attention currently being focused on CO2.

In this regards, the principal vehicle manufacturers in Europe have unanimously agreed to adopt an integrated approach which has as cornerstones the development of more fuel efficient power trains and weight reduction of the vehicle body. Today engine downsizing represents the most direct and cost effective approach to improving fuel efficiency in road vehicles in order to ensure significant reductions on the impact on the environment while still providing acceptable levels of performance and vehicle fun-to-drive.

Objectives:
However this new generation of engines, while being ideally suited to city vehicle applications, can result in a perceivable degree of deterioration in terms of noise and vibration when compared with the vehicles currently on the market.

Improvement of vehicle noise and vibration without affecting other performances is proving to be extremely difficult if not impossible with state-of-the-art technology. Frequently, new technologies in the fields of smart materials and active control provide potential solutions but have only been proved in the laboratory.

The objective of this project was to integrate such advanced laboratory-level technologies with conventional solutions with direct application to next generation city-car.

Methodology:
The concept of integrated noise and vibration solutions leads to a more efficient use of energy and weight savings in vehicles. Pursuing this in a holistic approach, Green City Car aims to demonstrate the feasibility of applying active systems to NVH-related problems of advanced power trains from a system point-of-view. This holistic approach should lead to a reduction in noise and vibrations levels in the order of 10 dB(A) and more, measurable in the city car provided. The overall expected results of the project were summarised as follows:

- provision of an holistic approach of noise and vibration control for city cars;
- validation of the feasibility of an integrated noise & vibration control on vehicle level having;
same interior noise, possibly reduced exterior noise with significant weight reduction and improved fuel consumption as compared to the state-of-the-art vehicle;

costs potentially competitive with conventional solutions;

provision of an integrated noise & vibration control on vehicle level resulting in significant less noise and vibrations levels at same weight and energy consumption;

increased modularity of integrated noise & vibration control;

increased acceptance of city cars with energy efficient power trains from comfort point of view.

**Parent Programmes:**

FP7-TRANSPORT - Transport (Including Aeronautics) - Horizontal activities for implementation of the transport programme (TPT)

**Institute type:** Public institution

**Institute name:** The European Commission

**Funding type:** Public (EU)

**Lead Organisation:**

**Fraunhofer Gesellschaft Zur Foerderung Der Angewandten Forschung E.v.**

**Address:**
HANSASTRASSE 27C
80686 MUNCHEN
Germany

**Organisation Website:**
http://www.fraunhofer.de

**EU Contribution:** €543,277

**Partner Organisations:**

**Continental Reifen Deutschland Gmbh**

**Address:**
Vahrenwalderstrasse 9
30001 Hannover
Germany

**EU Contribution:** €369,557

**Centro Ricerche Fiat - Societa Consortile Per Azioni**

**Address:**
Strada Torino, 50
10043 ORBASSANO (TO)
Italy

**Organisation Website:**
http://www.crf.it

**EU Contribution:** €525,650

**Bruel & Kjaer Sound & Vibration Measurement A/s**

**Address:**
Skodsborgvej 307
2850 Naerum
Denmark

**Organisation Website:**
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<td><strong>Rieter Automotive Management Ag</strong></td>
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**Technologies:**
- Noise testing, modelling and reduction
- Tools for noise and vibration reduction
**Development phase:** Validation

**Key Results:**
The following main results have been achieved within Green City Car:
- Set of validated stroke-amplified actuators
- 19% weight reduction on the existing sound package
- A new design for tires giving a good compromise between low resistance and low noise
validated active engine mount for the F 500
assessment of noise sources intensity of a city car
validation of feed-forward active engine noise controller
6-10 dB for idle conditions and more than 20 dB for a run-up at the entrance of the intake system by an active Helmholtz resonator
a prototype of the wireless sensor system for engine components
significant control of the first engine order of around 10 dB is achievable from around 1500 to 6000 rpm by cabin active noise control
reduction in engine noise of up to 7 dB(A) has been detected at front passengers' ears during an engine run-up in third gear with the adapted car

Innovation aspects

The project produced or developed a number of innovative concepts the most important of which are:

- Active Helmholtz Resonator
- Active Engine Mount
- Actuator
- Stroke Amplified Actuator

Two prototypes were set up:

- A stiff actuator with a resonance of 38 Hz
- A soft actuator with a resonance of 21 Hz

- Bending Beam
- Cup Spring with integrated piezoelectric elements

Technical Implications

For the transport industry, a switch to advanced materials and active system for noise and vibration control would also mean fewer parts and less weight (despite the added mass of the active system). It has been estimated that a 10% weight reduction translates into 4% fuel and emission reduction and that is why weight reduction ranks among the main targets of the transport industry to improve the environment friendliness. This gain can be highly increased when the holistic use of active systems for controlled NVH properties will be proved viable and widely used in the vehicle structure. According to a very conservative estimation of the automotive industry e.g., assuming an average yearly production of 350,000 cars over 8 years and a conventional mileage of 150,000 Km per car, a 10% weight reduction already gives a total saving of 61,000 tons of fuel, which means 200,000 tons less of CO2 released in the atmosphere. Considering in addition the possibility given by these high per-forming smart systems obtaining an extended transport components life cycle or a reduction by 50% of the time-to-market for new material integration in the transport supply chain, these numbers altogether illustrate the real potential of environmental hazards savings as well as for strengthening the competitiveness of the European industry.

Policy implications

The European added value factors of the Green City Car collaborative project include:

- Green City Car promotes European automotive industry and research to make efficient use of resources through efficient use of energy and light weight design for enhancement of a significant industry sector employing over 8% of the manufacturing workforce in the EU.
- Green City Car is responding to world-wide market-driven technology needs for future vehicles to help challenging the world-wide demand on sustainable and safe transport
- The Green City Car technology development will assist the European automotive industry to achieve and secure a leading position in the future.

Strategy targets
Innovating for the future:

- A European Transport Research and Innovation Policy
- Promoting more sustainable development

Documents:
- Final Report (Final report)

**STRIA Roadmaps:** Vehicle design and manufacturing

**Transport mode:** Road transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Decarbonisation, Environmental/Emissions aspects

**Geo-spatial type:** Other