Turbocharger acoustics and innovative noise control

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Content

1. Overview of the innovative flow-channel silencer:
   - the concept;
   - evaluation of dissipated acoustic power;
   - highlights.

2. Update on the Compressor acoustics:
   - the effect of on-engine installation to the passive acoustic performance.

3. Twin-scroll turbine acoustic characterization:
   - test-rig layout;
   - passive acoustic three-port formulation;
   - first results.
Overview of the innovative flow-channel silencer: the concept

- Lightweight and compact noise control solution for flow duct applications (e.g. IC engine compressors).

- Consist of straight-flow channel with included acoustic resistance and locally reacting cavity.

- The surface resistance is matched to the Cremer optimal impedance model*.

Overview of the innovative flow-channel silencer: the evaluation of dissipation

\[ TL_{\text{dis}} = 10 \log_{10} \left[ \frac{1 - |R|^2 (1 - M)^2}{(1 + M)^2} \right] |T|^2 \]

\[ TL_{\text{ref}} = -10 \log_{10} \left[ 1 - |R|^2 \frac{(1 - M)^2}{(1 + M)^2} \right] \]
Overview of the innovative flow-channel silencer: **highlights**

- Highlights of the silencer concept:
  1. negligible pressure drop;
  2. compact;
  3. lightweight;
  4. highly dissipative (no fibrous materials)
  5. relatively robust in terms of mean flow changes and whistling;
  6. computationally inexpensive to simulate (assuming analytical impedance model).

Update on the compressor acoustics: The effect of on-engine installation

Figure 8: Comparison between the ideal operation and pulsating flow operation for Compressor-variant 2. 

Acoustic characterization of Twin-scroll turbine: passive acoustic 3-port model

The **OP of the turbine** is set by means of **WG position** and corresponding OP in the **compressor map**.
Acoustic characterization of Twin-scroll turbine: passive acoustic 3-port model

In general:
- below 1 kHz the TL between inlet and outlet channels is the same in case of both inlets;
- the TL between two inlets is in the order of TL between inlet and outlet;
- the reduction of downstream TL, caused by opening of the WG, remains as small as ~4dB below 1kHz.
Thank you for your attention.