Competence Center Gas Exchange

CCGEx

"Charging for the future"

Turbocharger acoustics and innovative noise control

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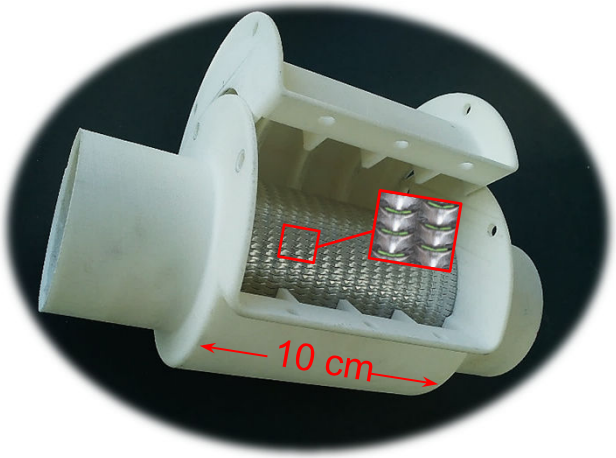
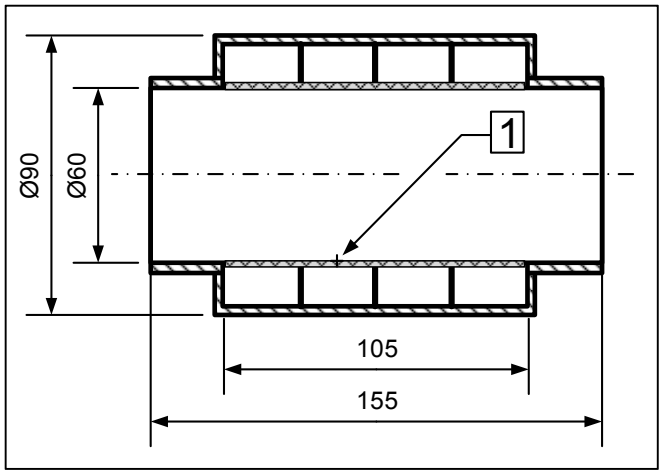
Overview of the innovative flow-channel silencer: **the concept**

- 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*.



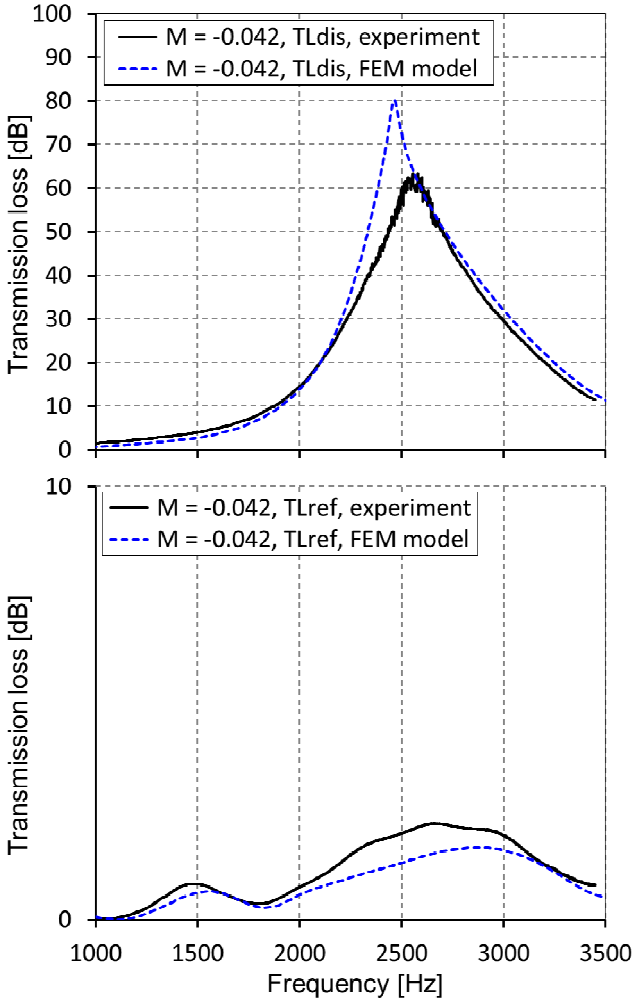


* Kabral R., Du L., Åbom M., “Optimum sound attenuation in flow ducts based on the "exact" Cremer impedance,” Acta Acustica united with Acustica 102(5): 851-860, 2016.

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

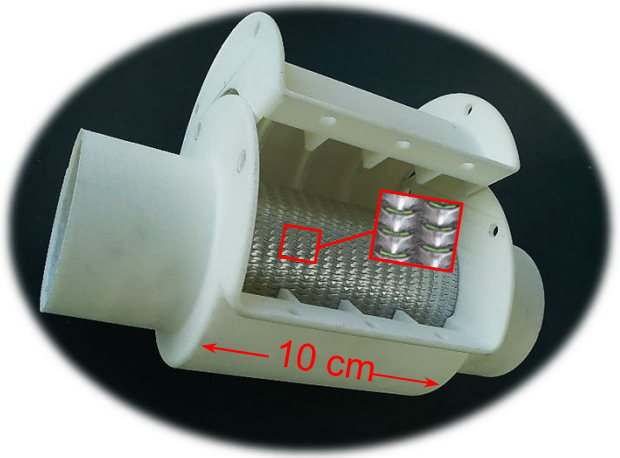
$$TL_{dis} = 10\log_{10}\left[\frac{1-|R|^2\frac{(1-M)^2}{(1+M)^2}}{|T|^2}\right]$$

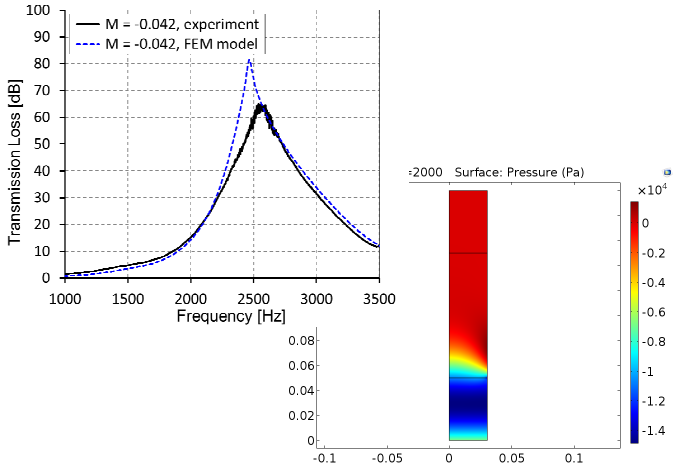
$$TL_{ref} = -10\log_{10}\left[1-|R|^2\frac{(1-M)^2}{(1+M)^2}\right]$$



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).





* Kabral R., Du L., Åbom M., “Optimum sound attenuation in flow ducts based on the "exact" Cremer impedance,” Acta Acustica united with Acustica 102(5): 851-860, 2016.

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

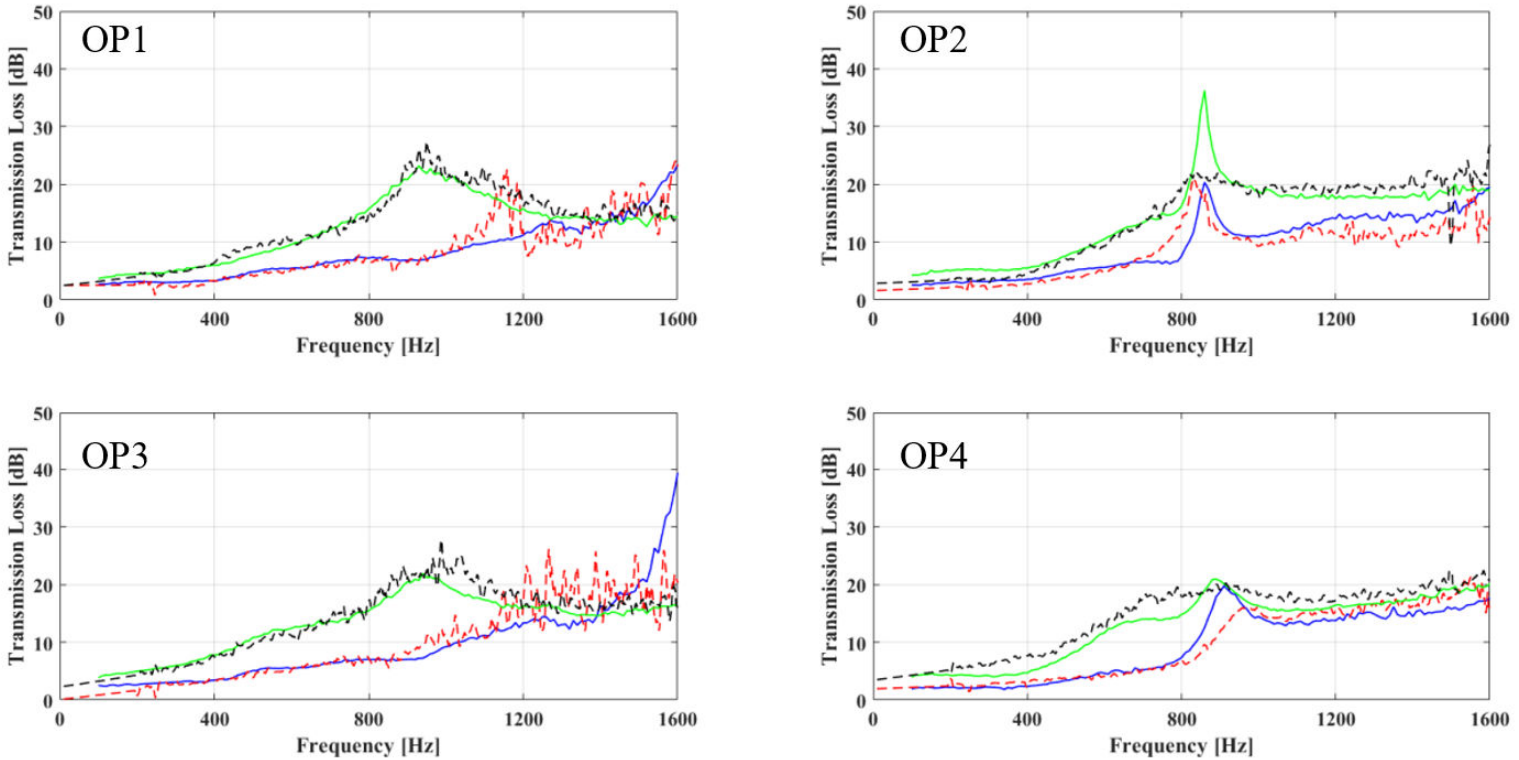
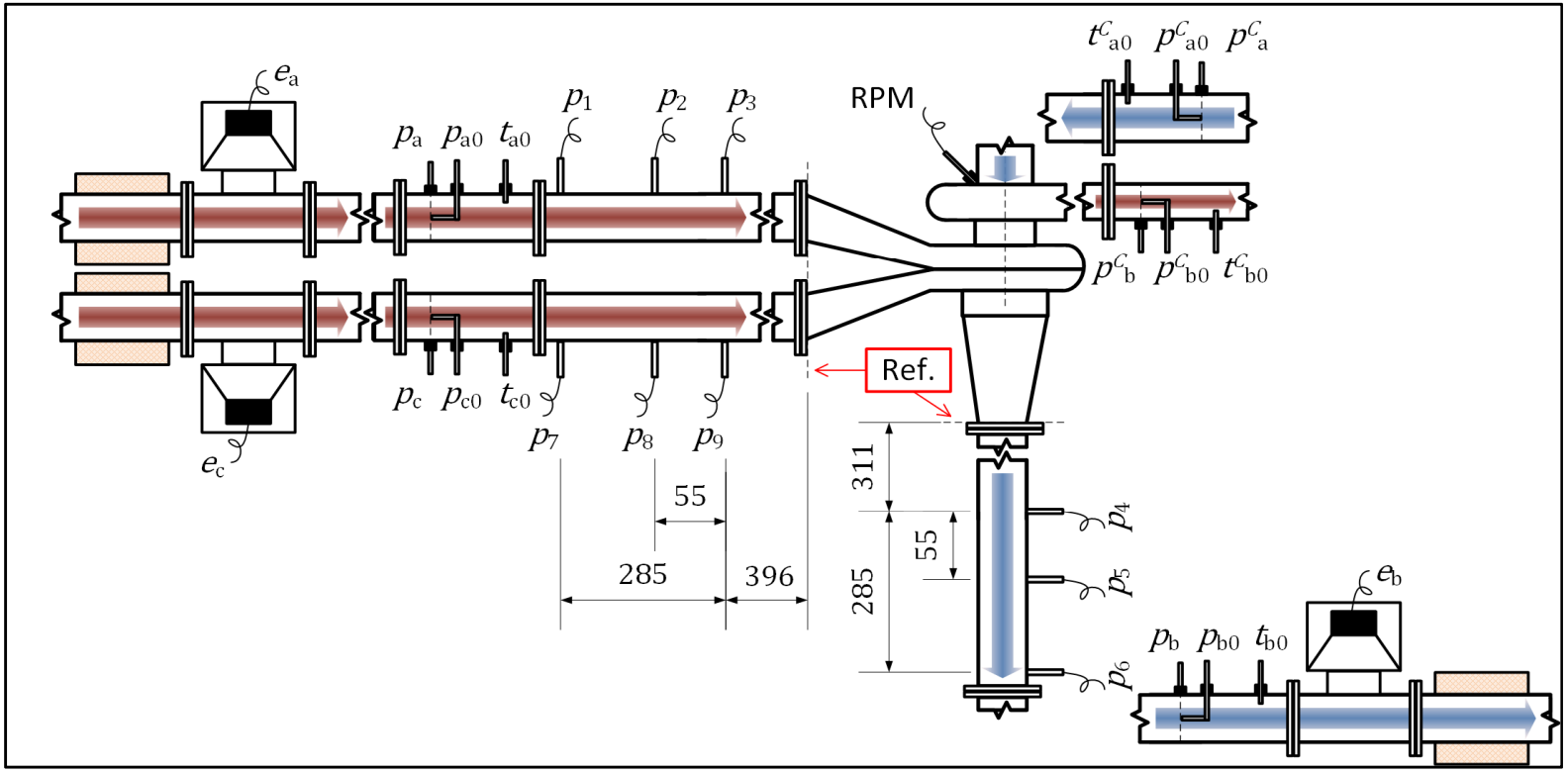


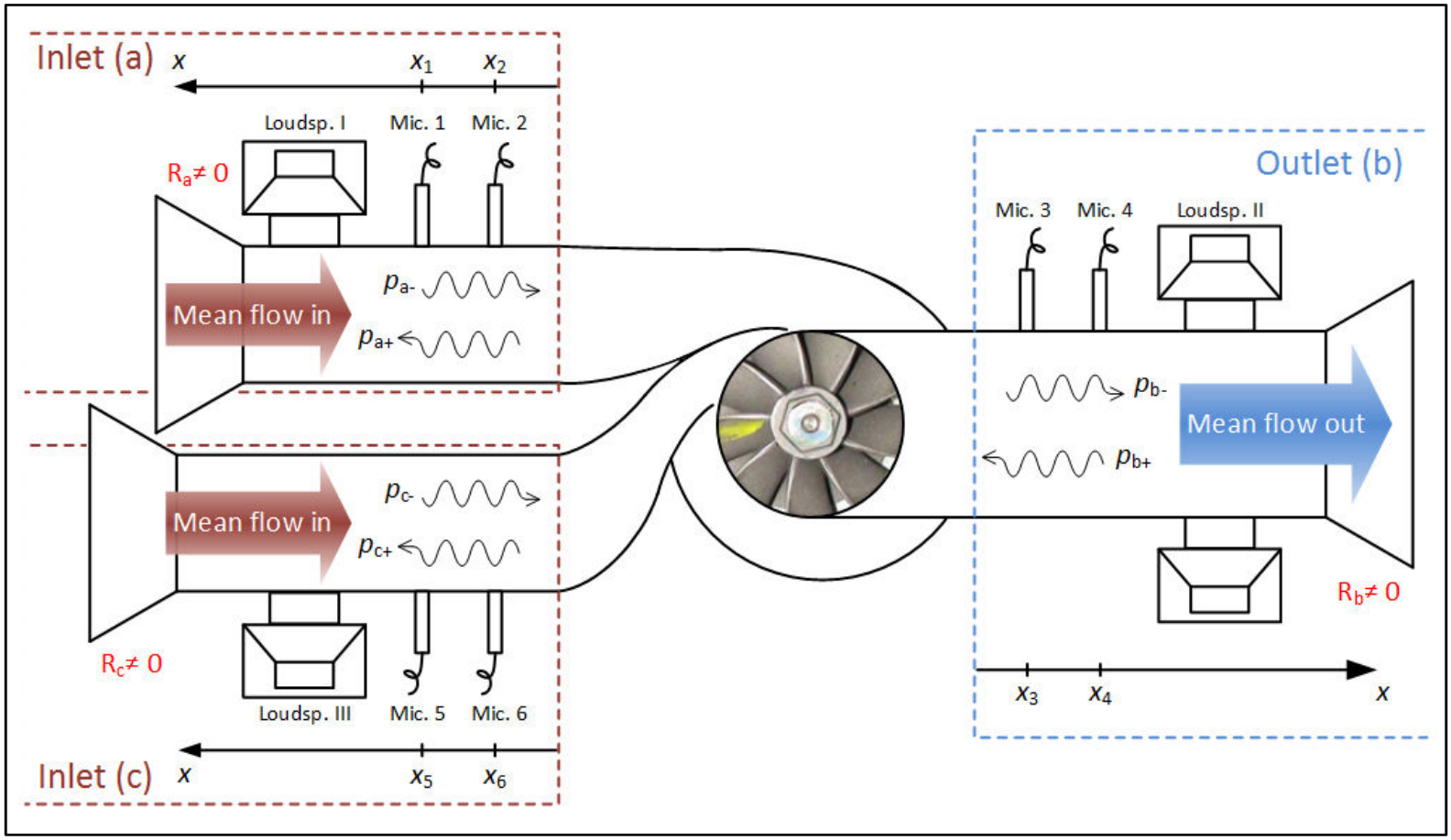
Figure 8: Comparison between the ideal operation and pulsating flow operation for Compressor-variant 2. Downstream KTH, Downstream IVT, Upstream KTH, Upstream IVT

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



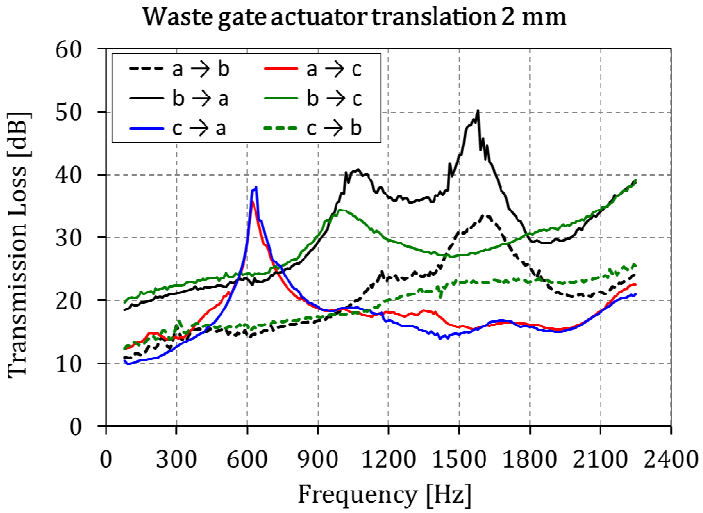
The **OP of the turbine** is set by means of **WG position** and corresponding OP in the **compressor map**.

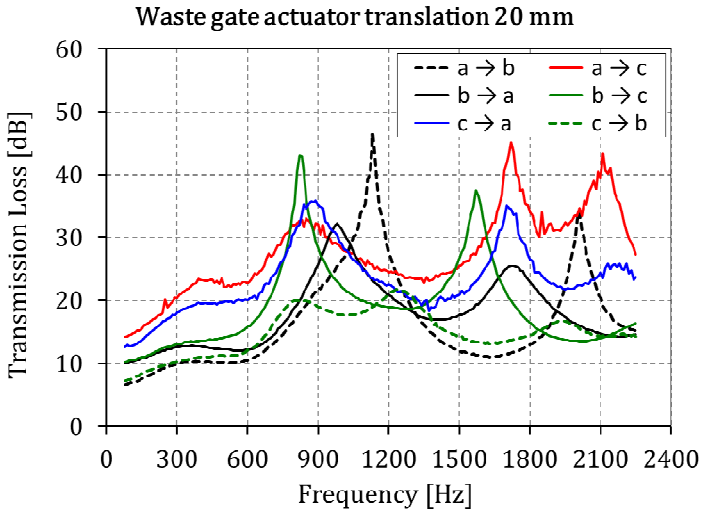
Acoustic characterization of Twin-scroll turbine: **passive acoustic 3-port model**



* Kabral R., El Nemr Y., Ludwig C., Mirlach R., Koutsovasilis P., Masrane A., Åbom M., "Experimental Acoustic Characterization of Automotive Twin-scroll Turbine," Euroturbo conference 2017 Stockholm – **submitted**.

Acoustic characterization of Twin-scroll turbine: **first results**





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.

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Thank you for your attention.