



Study of a cold flow combustor

L.B.W. Peerlings

Susann Boij, Hans Bodén and Ines Lopez Arteaga

Introduction

- Goal of the project
 - Study of combustor geometry without combustion
 - Area Expansion
 - Mimic the acoustic effect of combustion by an actuator
 - Deeper understanding of the interaction between acoustics, hydrodynamics and combustion.

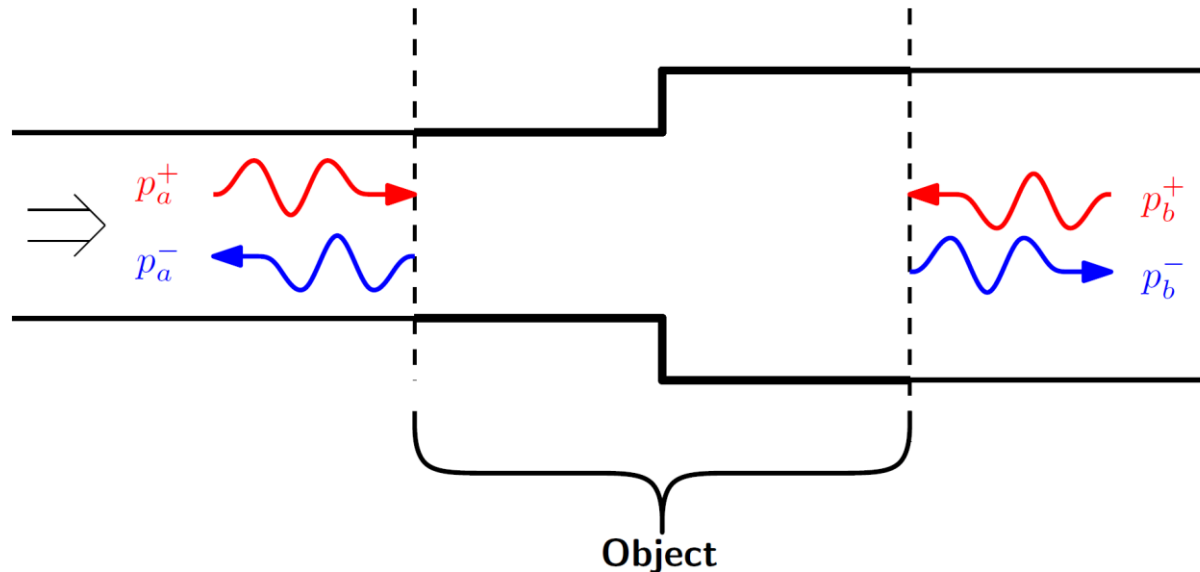
Area expansion

- Goal
 - Relation between up- and down-stream acoustic fields
 - Interaction between hydrodynamic and acoustic field
 - Provide accurate data for numerical comparison
- Methods
- Validation
- Experimental setup
- Preliminary results
- Outlook

Area expansion: Methods

- Linear two-port analysis
 - Scattering matrix representation

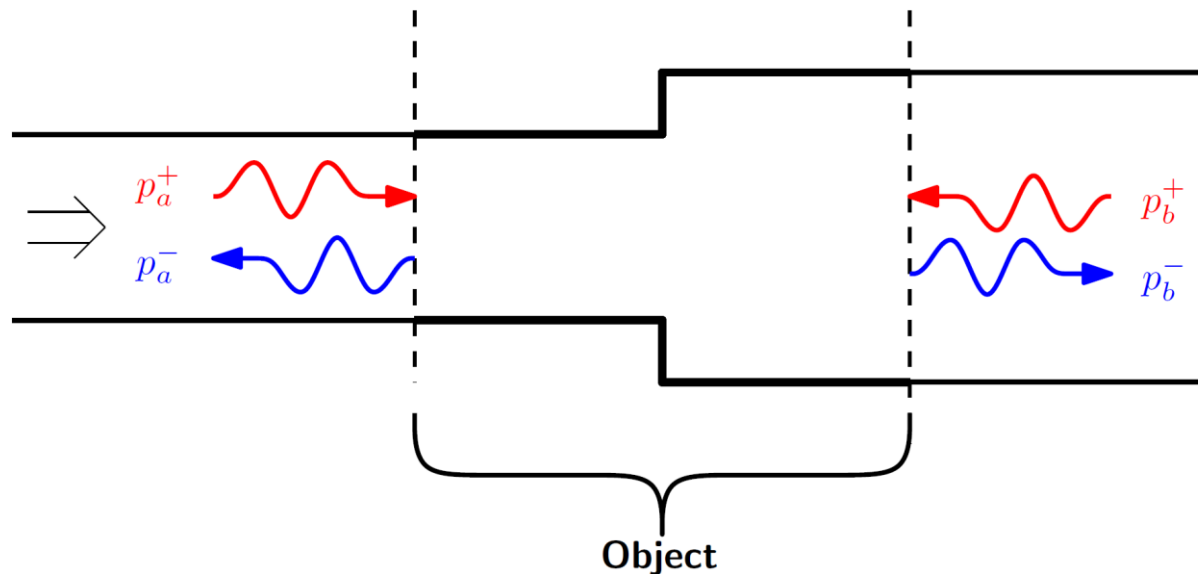
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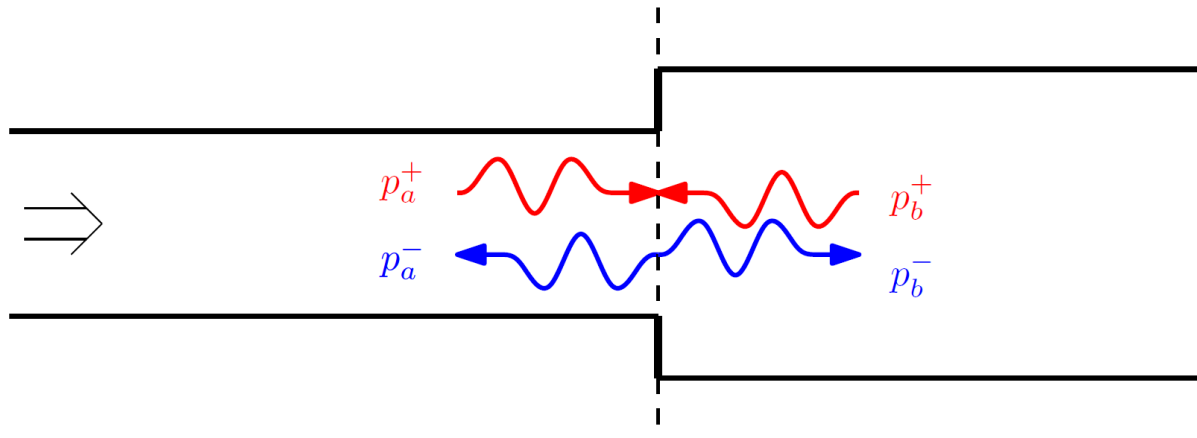
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 - Multi-microphone method¹
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 - Detailed model of the speed of sound⁴
 - Rejection of signals with large harmonic distortion

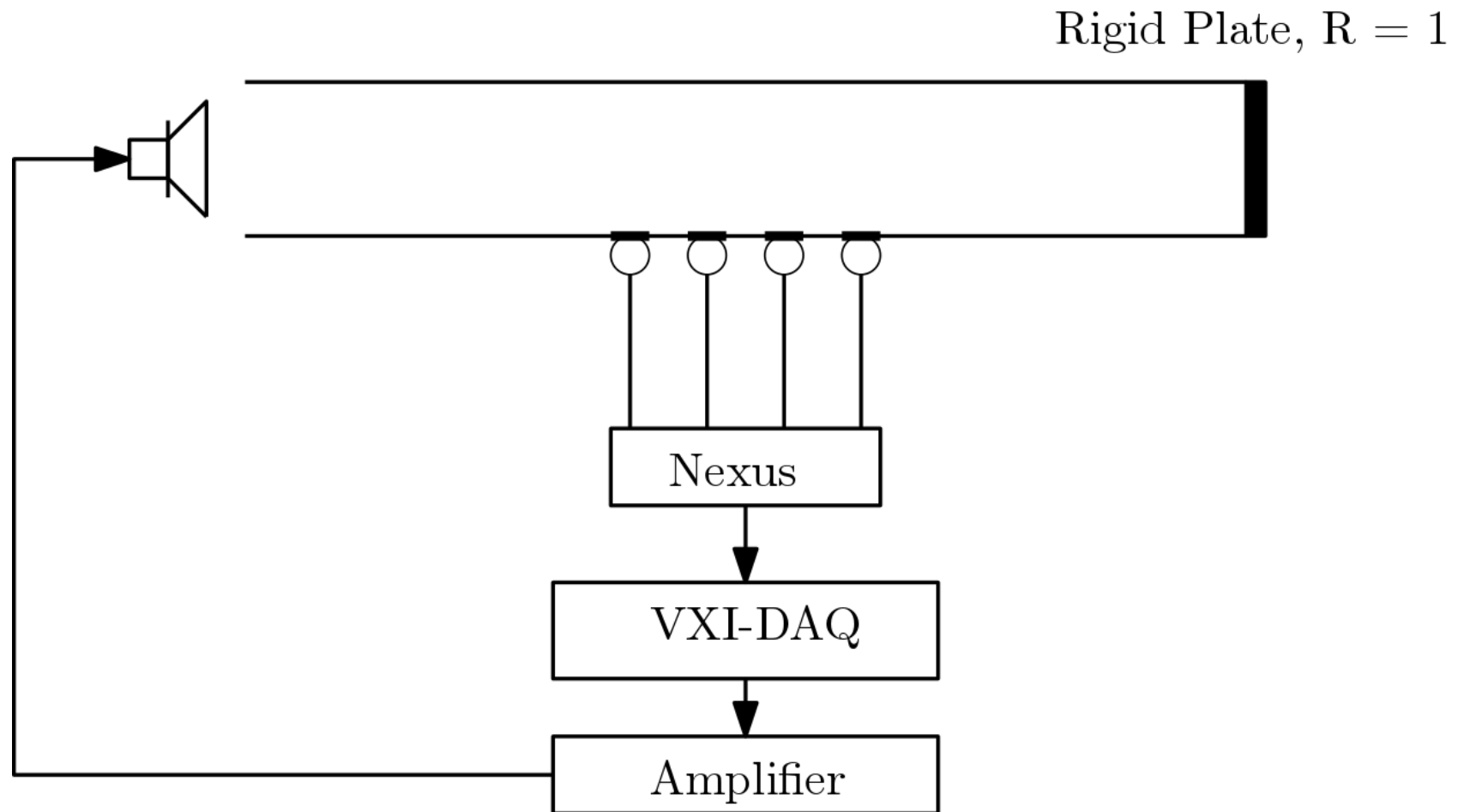
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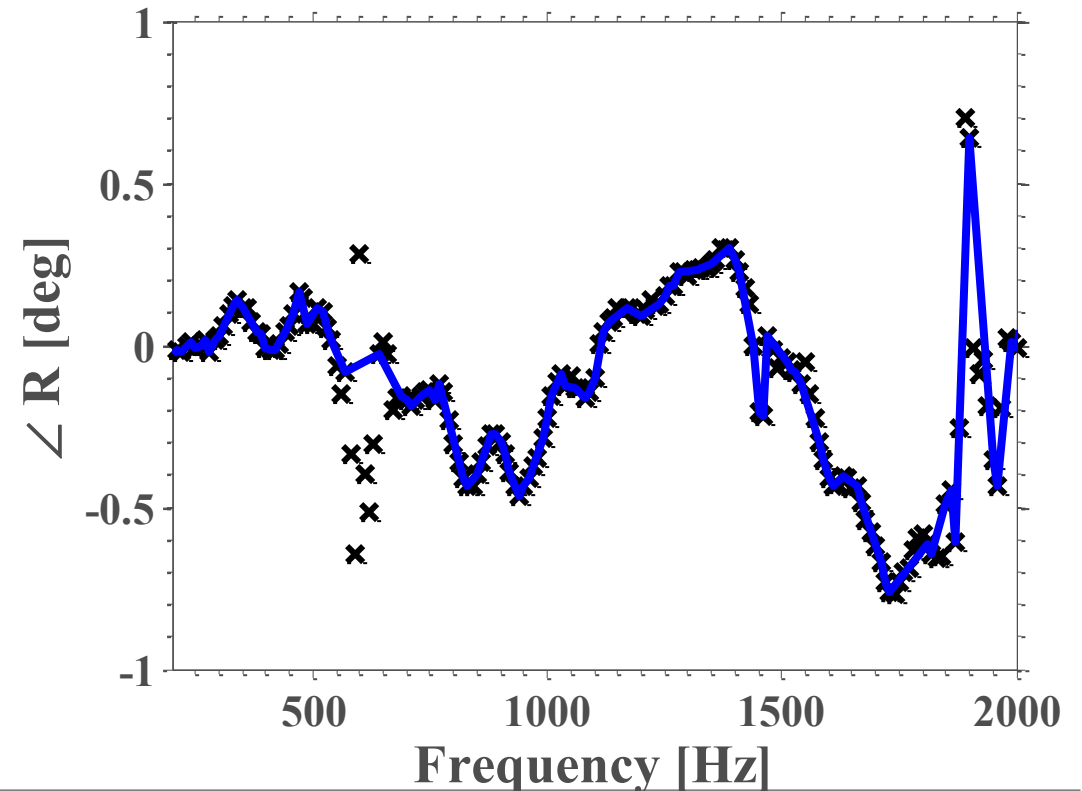
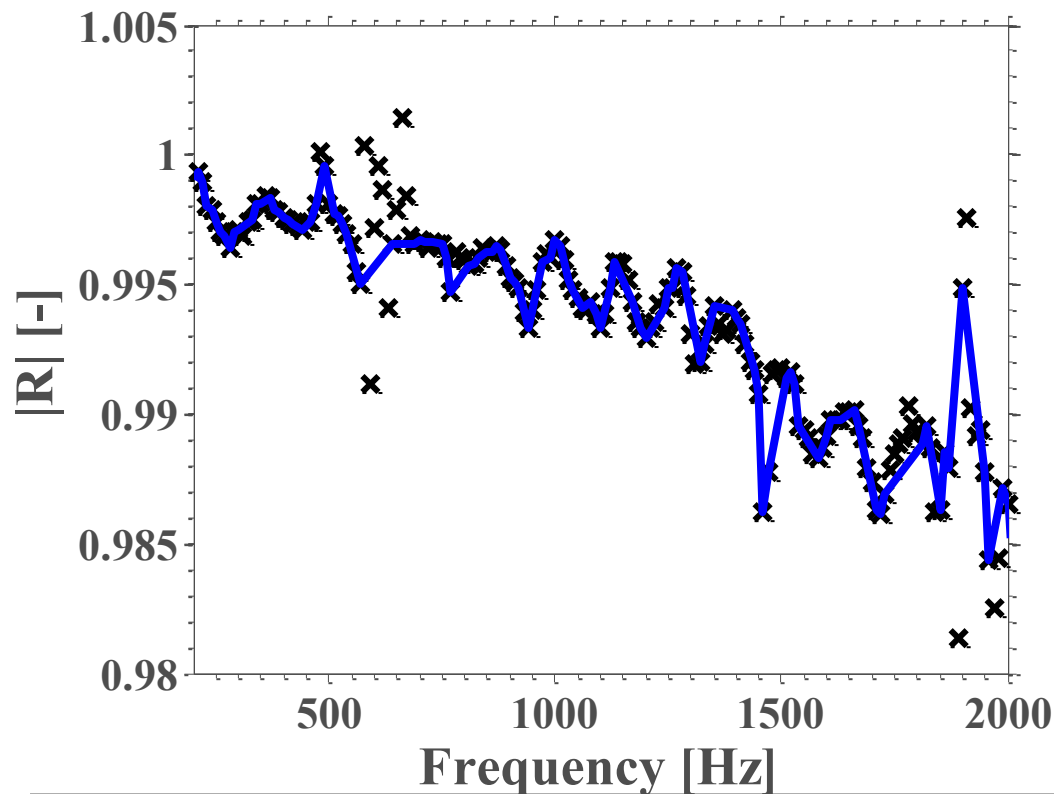
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Area Expansion: Validation



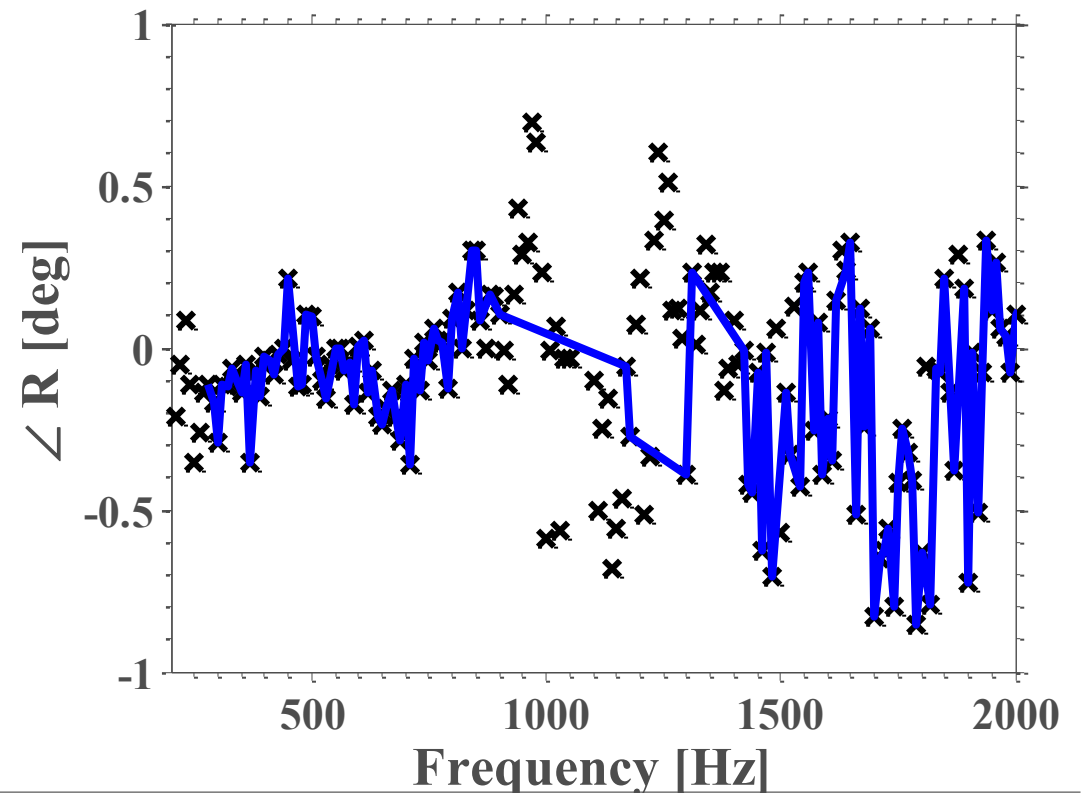
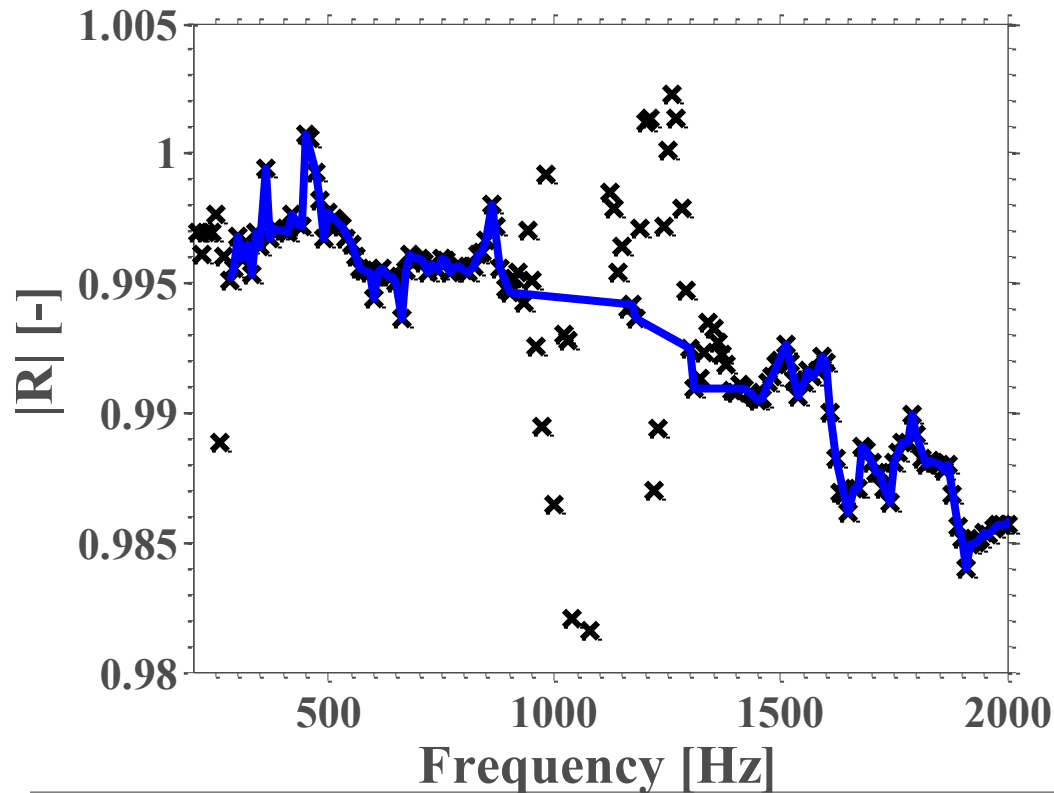
Area Expansion: Validation

- Reflection coefficient Rigid plate large pipe



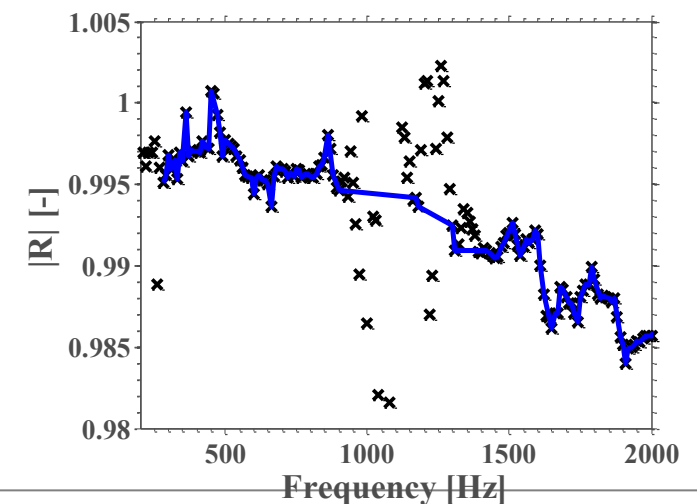
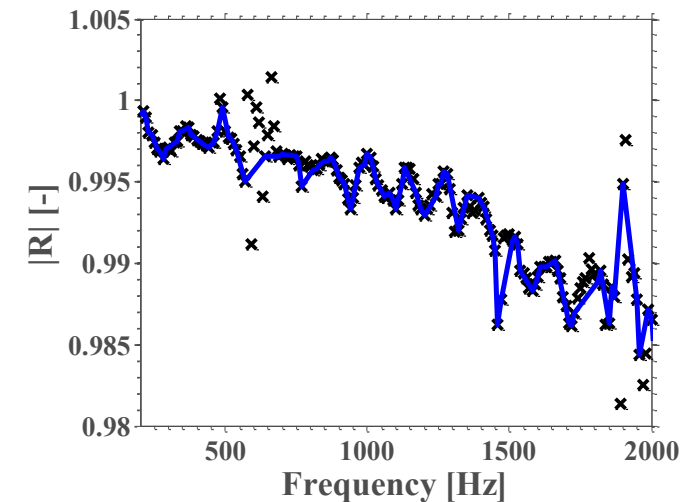
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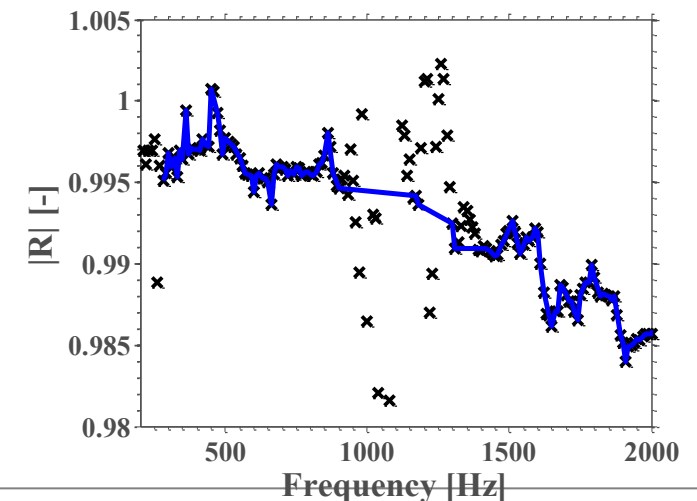
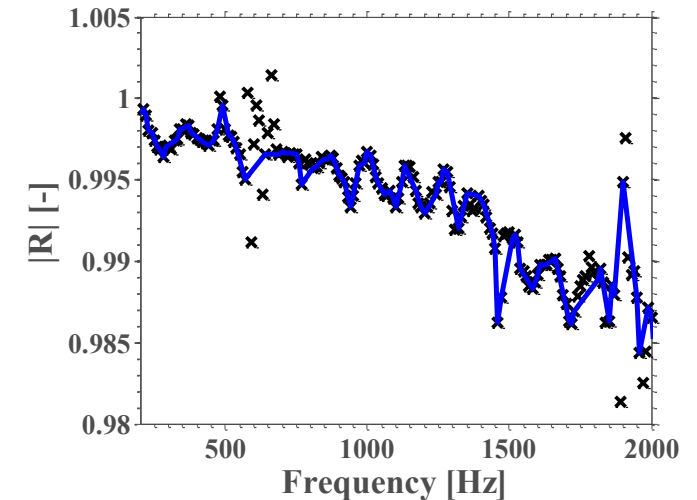
Area Expansion: Validation

- Accurate determination of the reflection coefficient
 - $|R| < 2\%$ error
 - $\angle R < 1^\circ$



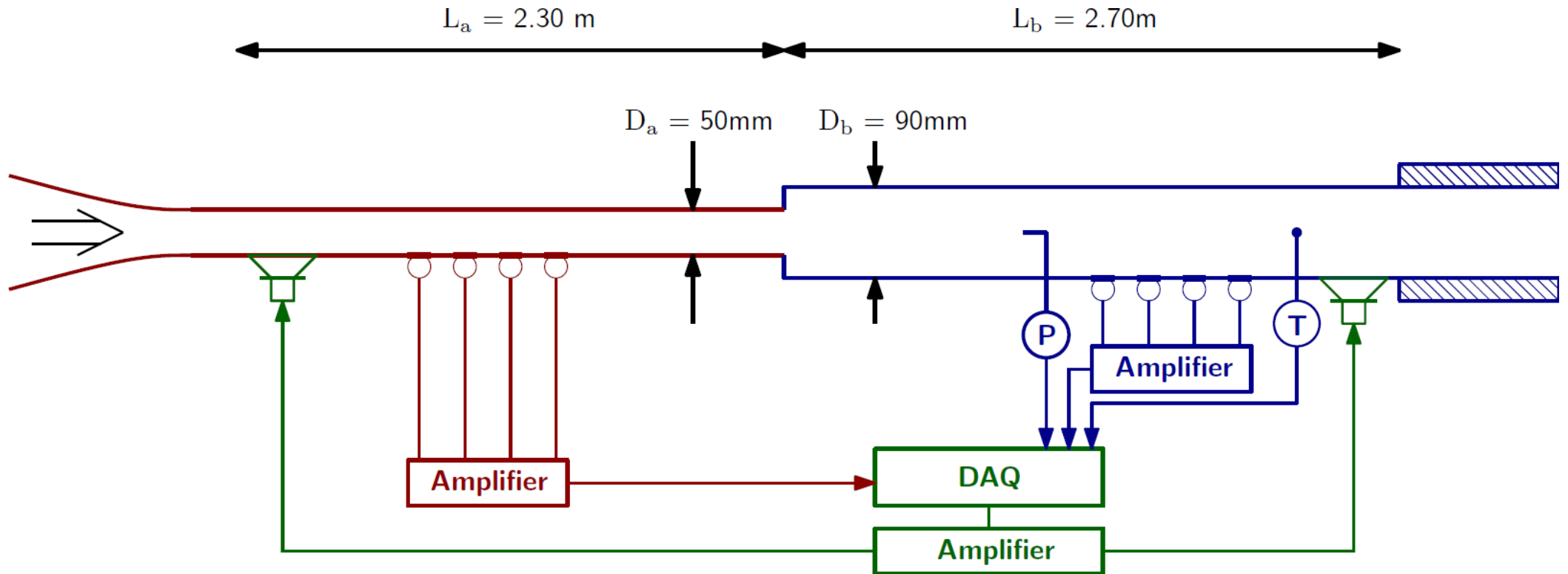
Area Expansion: Validation

- Systematic deviation from $|R| = 1$
 - Ahrens¹ reported a similar observation
 - Due to acoustic losses?
- Similar experiences?

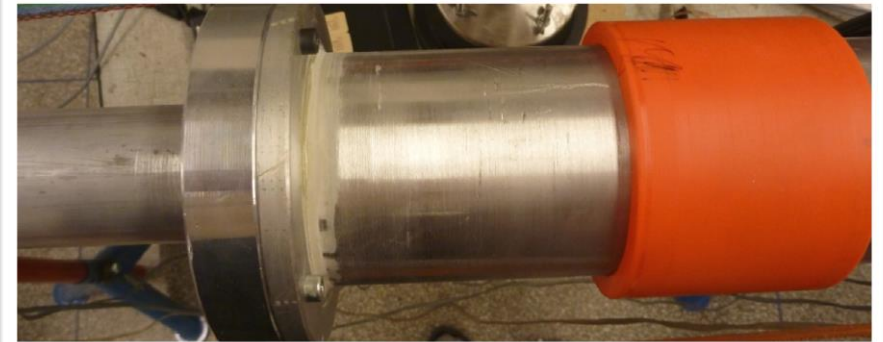


¹ C. Ahrens (1971), *Acustica* **25** *Luftschalldämpfung in durchströmten rohren*

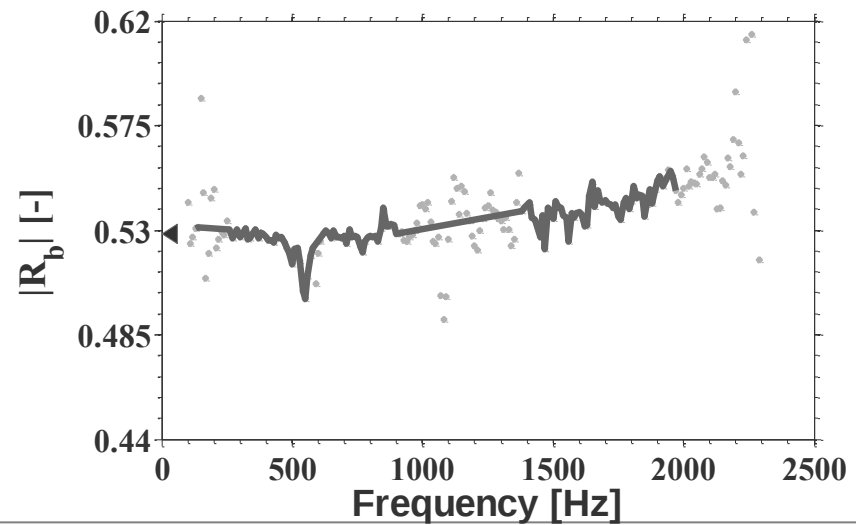
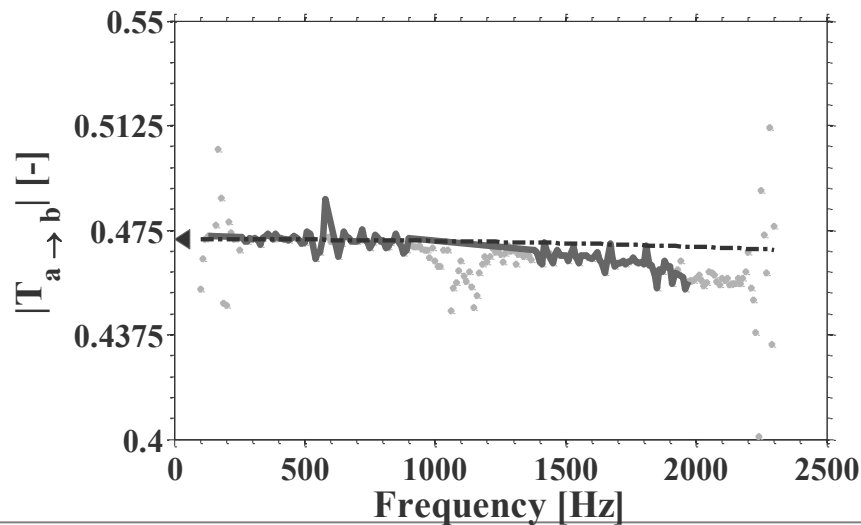
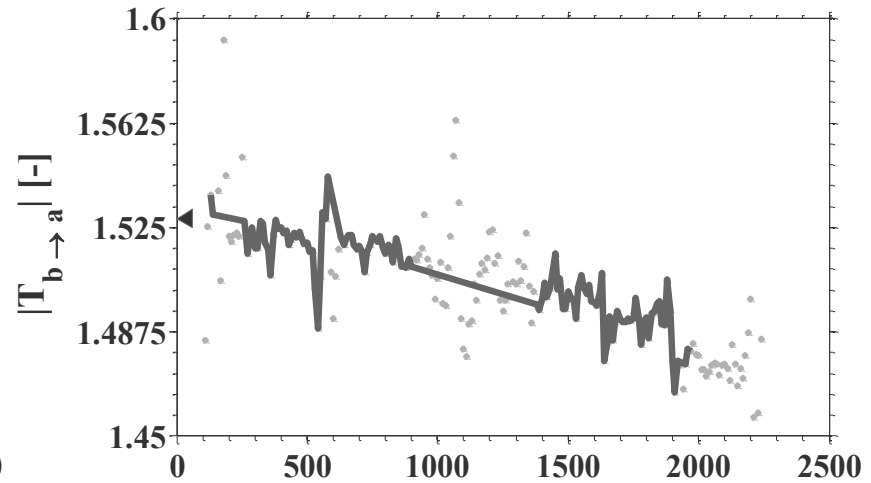
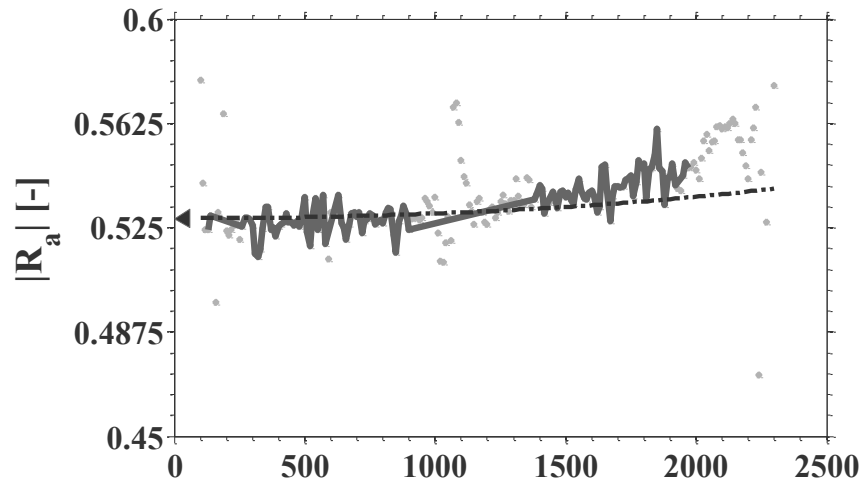
Area expansion: Setup



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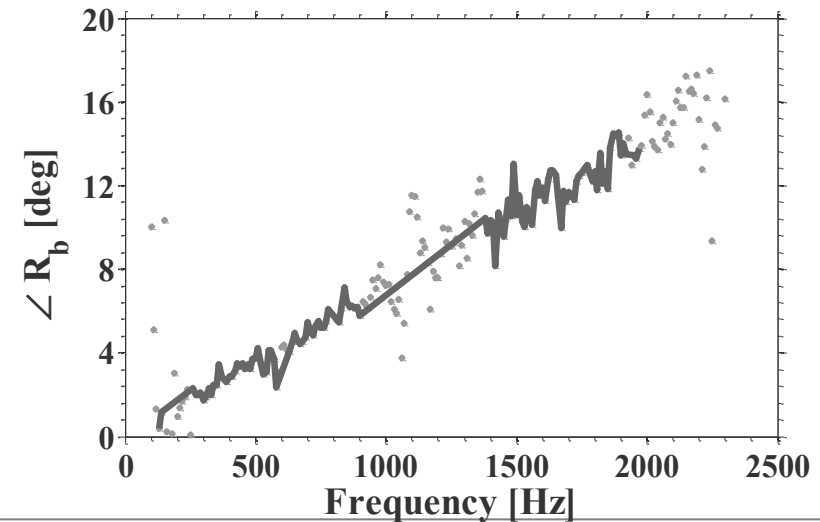
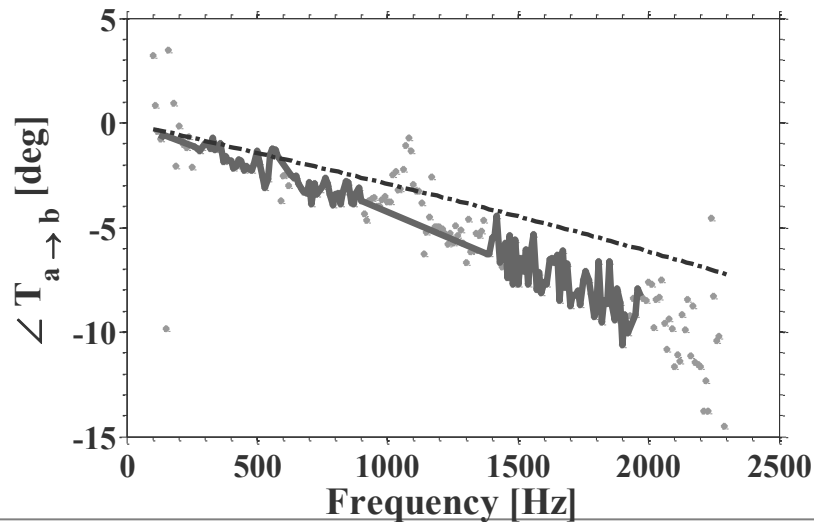
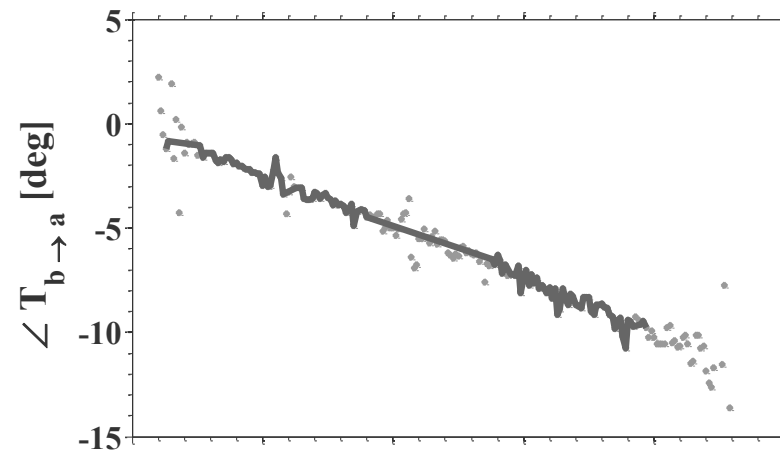
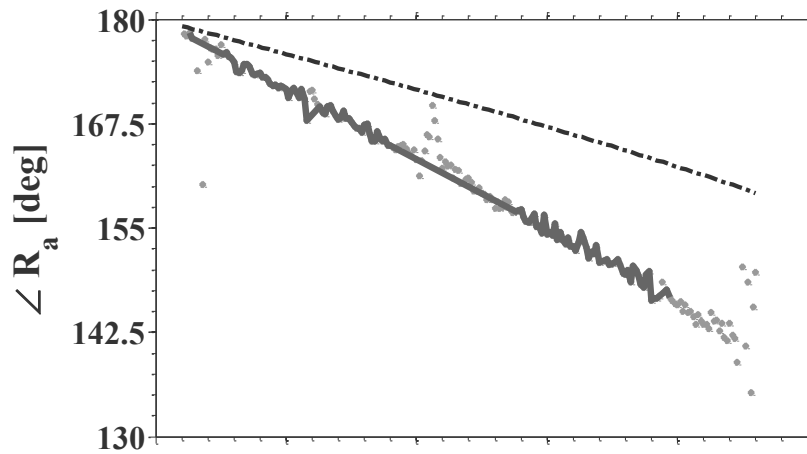


Area Expansion: Results No Flow



¹: Y.Auregan & A. Debray (2001), J. Sound Vib. **243** doi:10.1006/jsvi.2000.3424

Area Expansion: Results



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Area Expansion: Conclusion and Outlook

- Conclusion
 - Accurate measurements
 - $|S| < 2\%$
 - Good comparison with analytical models
 - Deviation in $\angle S$
- Outlook
 - Performing measurements with flow
 - Determination acoustic source vector



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 - Accurate measurements
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- Outlook
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- Ideas to improve the results ?

Questions ?