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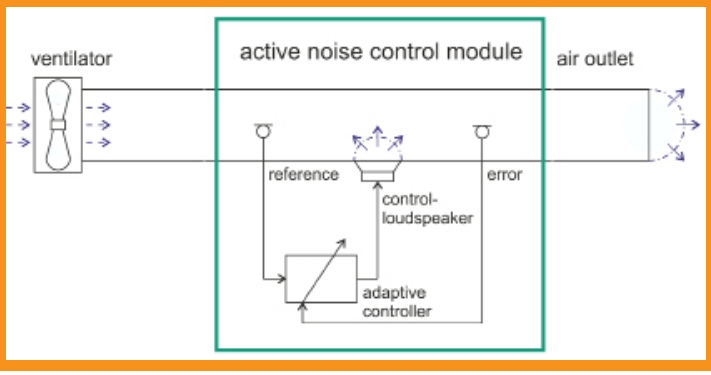

2

1 *Active noise control module*

2 *Scheme of a classical Feed Forward Active Noise Control Setup for ventilation ducts*

ACTIVE NOISE CONTROL MODULES FOR VENTILATION DUCTS

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Modern homes and office buildings are often equipped with forced ventilation and air conditioning systems. From an acoustical point of view this may cause problems due to disturbing noise emissions and unwanted sound transmissions from adjacent rooms and corridors. Compact active noise control (ANC) modules based on the principle of active anti-sound can be used to reduce acoustic disturbance, improve acoustical comfort and to protect privacy. In this Project the Fraunhofer LBF explores ANC concepts and develops practical compact active noise control modules, integrated with adequate passive acoustic measures; with the aim to increase the application readiness of this innovative technology.

Development of an active noise control module

Usually the passive silencers with porous absorption material and or passive Helmolz-resonators are used to control the sound transmission in ventilation systems. At low audio frequencies passive solutions are often not appropriate, since disproportionately large silencers would be needed. In particular for the control of low audio frequency noise emissions and transmissions ANC-Systems based on the principle of active anti-sound can be an adequate alternative; and can be more compact and cost efficient then passive solutions.

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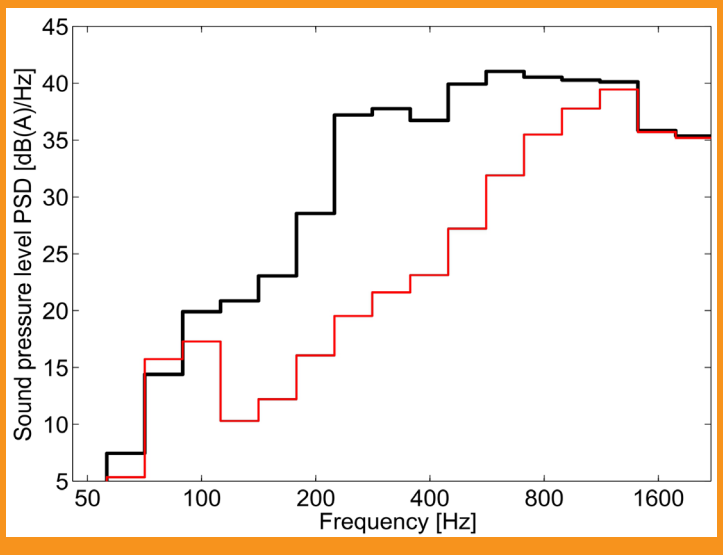
3 *Ventilation system with ANC-Module installed on an office container*



4 *Sound pressure levels in the receiving room: ANC-OFF (black) and ANC-ON (red) for Loudspeaker primary excitation*

Since ANC-systems are relatively complex, so far, practical implementation has been limited to a small number of specialized applications. An important step towards a wider commercial application of ANC-Systems for ventilation systems is the development of modular plug and play solutions, which satisfy the practical marked requirements for cost-efficiency, compactness and handling. Aim of this research project is the development of a compact ANC-module based on a single channel feed forward adaptive control strategy. For this purpose a ventilation system with an ANC-system has been installed on an office container. In experimental studies this demonstrator has been used to investigate the control performance for various configurations of the ANC-module. Apart from the optimization of the control algorithm, the relative and absolute locations of the reference and error sensors and the control loudspeakers within the ventilation system have also been investigated and optimized. Since ANC is mainly efficient at low audio frequencies, it has also been investigated how an ANC-module may be combined and integrated with appropriate passive acoustic measures in order to achieve an optimised broad band control performance.

So far a robust control algorithm has been developed and implemented, which has been tested for loudspeaker primary excitation and during the operation of a standard radial fan. In both cases significant reductions are achieved for the sound levels inside the office container, which can also be clearly perceived subjectively. The function of the developed ANC-module has been demonstrated for both, the installation within the ventilation system and for the installation directly in front of the air outlet.

In future it is planned to conduct studies on the integration of acoustic masking and sound design functionality into the ANC-System. Eventually the laboratory sensors that have been used in the experimental studies ought to be replaced by appropriate practical low-cost sensors. Also, in view of potential commercial applications the computational cost of the control algorithm needs to be optimized. Other studies will focus on the scalability of ANC concepts in order to also develop concept solutions for larger scale industrial applications and smaller scale automotive ventilation and exhaust systems.

Based on the experience gained from this project, the Fraunhofer LBF will be able to systematically analyse customer specific problems and develop of innovative concepts for modular active noise control systems, for the control of sound transmission in ducts and of noise emissions from ventilation and exhaust systems.

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