Acoustic Services at Philips Applied Technologies

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Introduction

Within the Philips community and beyond, Philips Applied Technologies provides acoustic services under the umbrella of our mechatronics activities. Combined with Philips ATC in Drachten we service most divisions of Philips Consumer Lifestyle, Healthcare and Lighting, as well as various technology groups inside and outside Philips, worldwide. Acoustics knowhow and a fast access to closely related technologies e.g. flow and thermal management, for a broad range of application domains, is amply available within the grounds of the Philips High Tech Campus at Eindhoven.

Soundpower of various Philips Products

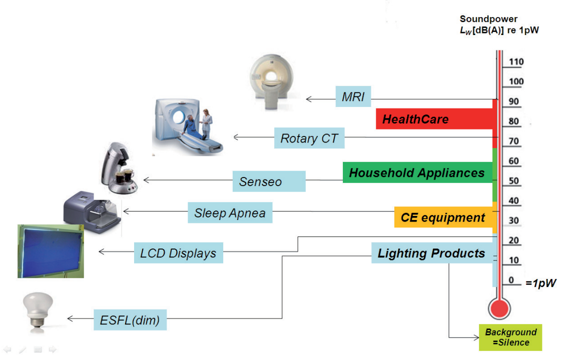

Figure 1: Noise level of typical Philips products.

Product Range

The type of products we work on, in joint effort with application experts in production groups, range from MRI systems to small surface mounted components. The acoustics therefore range from over 90 dB(A) to below 20 dB(A) in sound power level. This requires proper measurement facilities, such as a reverberant room, a fully anechoic room as well as an advanced acoustic imaging tool which can be used on location. Since acoustic solutions are often restricted by the application we need innovative analysis and breakthrough solutions, to improve the quality of the products under consideration. Operating closely with the application experts also provides a way for acoustic solutions to be designed into the application. The poster presented addresses some cases from the Philips product range and explains how new technologies are used for challenging acoustic cases.

Analysis Tools

A wide range of analysis tools is required for proper noise control engineering as well as close contact with the application engineers to make sure the applied measures fit the specifics of the application domain.

	Measurement Methods		*Numerical Methods*	
Airborne Sources	Acoustic imaging		BEM *(acoustic radiation)*	
Structure born Sources	Laser Vibrometry		FEM *(mechanical vibrations)*	
Magnetic Sources	*(Magnetic Imaging)*		Opera *(electro-magnetics)*	
Flow related imaging	*(PIV, high speed camera)*		FlowTherm *(flow & cooling)*	

Figure 2: Analysis tools for Low Noise Design.

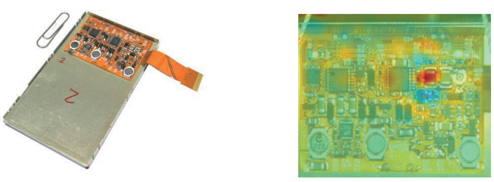

Figure 3: Noise source localization by Near Field Acoustic Holography on small PCB.

Case Studies:

Lighting

Lighting products are designed for low noise levels in the range around L_W 20 dB(A) and lower. Note that more and more complex current profiles are applied to optimize lighting performance. Such alternating current cause vibrations in components and may result in unwanted noise. Even for low noise levels annoyance criteria based on tonality are applied..

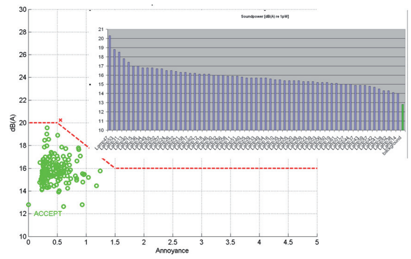

Figure 4: Sound power –Annoyance diagram of a batch of low noise designed lighting products.

Lifestyle

For many lifestyle products in the consumer environment, forced cooling by means of fans is a necessity. Thermo-acoustic optimization [1] has been a very useful tool which requires close cooperation with thermal and reliability experts. We have been able to devise an analysis tool which allows us to evaluate if a product is near its thermo-acoustic optimum design or not. This has been tested on hard disc recorders and similar products.

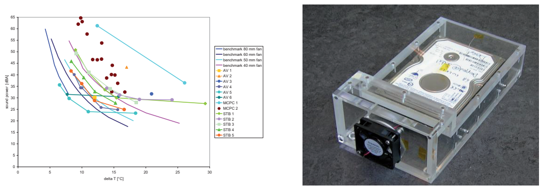

Figure 5: Thermo-acoustic optimization diagram for fan cooled products (ref: ITHERM08).

Healthcare

MRI systems deliver high resolution medical images but also produce a loud noise originating from the gradient coil vibrations. Decoupling has been analyzed by means of active vibration control resulting in a lowering of the cryostat noise contribution. The acoustic imaging tool we use to optimize the acoustic shielding inside the patient bore.

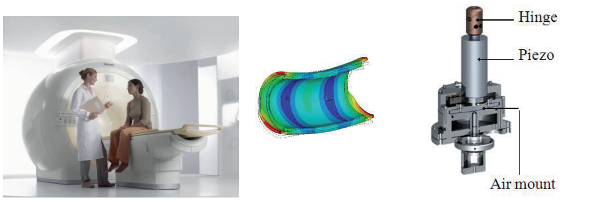

Figure 6: MRI gradient coil dominant vibrational mode decoupled by active isolator.

Industry

Often in-situ measurements are required as in the case of the Grasso pump [3]. A noise ranking was executed, based on system and signal analysis. This was followed by an in situ modal analysis of the top plating. Model based design was followed by an evaluation study. This resulted in a cost down low noise redesign with acceptable noise level.

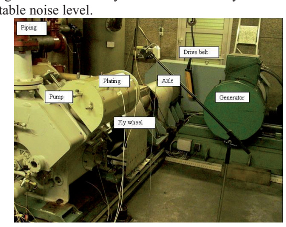

Figure 7: On-site noise analysis of industrial machine.

References

[1] *Philips Internal Report*.

[2] "Forced convection cooling benchmark study of a HDD in various consumer electronics applications", ITherm08, R.van Es, A. Geerlings, June 2008.

[3] "Active Vibration Control of Gradient Coils to Reduce Acoustic Noise of MRI Systems", N. B. Roozen, A. H. Koevoets, and A. J. den Hamer, IEEE/ASME Transactions on mechatronics, Vol. 13, No. 3, June 2008

[4] "Sound Source Identification and Noise Reduction of a Reciprocating Compressor", N.B. Roozen, J.van den Oetelaar, A.C. Geerlings, T.. Vliegenthart, NAG-DAGA 2009.

REFERENCE: APT536-09-7150