Analysis of acoustic noise transfer function in MRI: multi-center trial

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INTRODUCTION:

Acoustic noise during magnetic resonance imaging (MRI) scan is influenced by imaging parameters and pulse sequences [1]. It varies due to many kinds of factors such as structure, materials, and magnetic field strength [2]. The purpose of our study is to evaluate characteristics of acoustic noise independent of MRI scan protocol. We determined a gradient-pulse-to-acoustic-noise transfer function (GPAN-TF) at various MRI centers [3].

METHODS:

We measured sound pressure levels *P*(*f*) in the frequency domain in six clinical super-conducting MRI systems (1.5 T and 3.0 T) when applying a simple narrower trapezoidal gradient pulse *G*(*f*). We calculated a GPAN-TF [dB/(mT-m^{-1})] in each gradient coil, i.e., X, Y, and Z-axis, by the deconvolution process (Eq. (1)).

$$H(f) = \frac{P(f)}{G(f)} \qquad (1)$$

RESULTS AND DISCUSSION:

GPAN-TF at a high frequency range (1000 to 10000 Hz) was larger than that at low frequency for all MR scanners. Three same MRI machines had similar GPAN-TF in spite of much different room construction, i.e., independent of room construction during scan (Fig. 1). For high frequency (>1000 Hz), the 3.0-T MR scanner had a larger GPAN-TF than that of 1.5-T (Fig. 2). MR scanner with a vacuum chamber reduced GPAN-TF at a lower frequency (<1000 Hz), but this effect decreased at higher frequency (Fig. 3). This result shows that the acoustic noise reduction effect by the vacuum chamber gradient system for fast sequences is not so high.

CONCLUSION:

GPAN-TF analysis makes it possible to obtain more detailed information on acoustic noise properties independent of pulse sequences or imaging parameter in MR scanner. It may be useful for development of a silent pulse sequence, and for prediction of acoustic noise.

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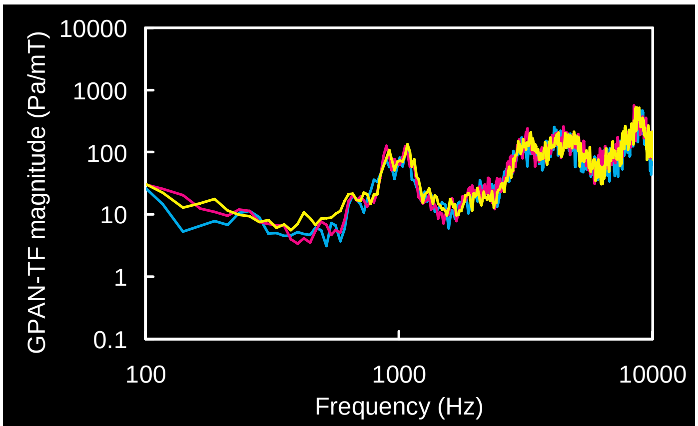

Fig. 1. GPAN-TF of X-gradient coil for three same 1.5 T MRI machines (but different room construction).

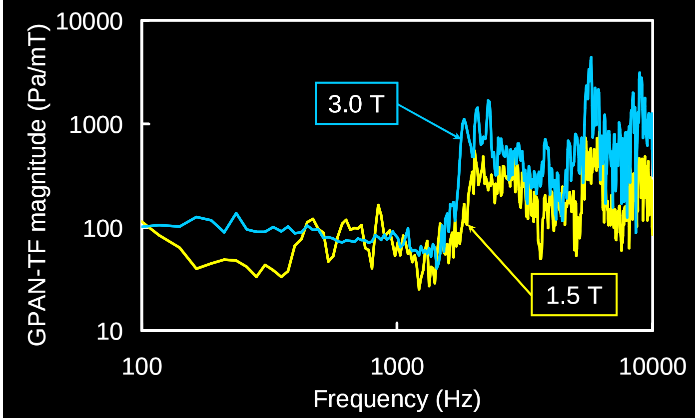

Fig. 2. GPAN-TF for 1.5 T and 3.0 T imagers.

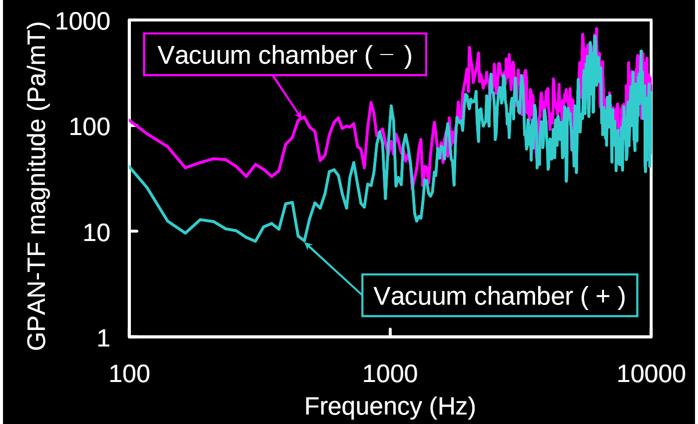

Fig. 3. GPAN-TF with and without gradient coils sealed inside a vacuum chamber.