Title: Assessment of a novel 32-channel phased array for cardiovascular hybrid PET/MRI imaging: MRI performance

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Structured Abstract:

Introduction: Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) PET/MRI systems have been used in cardiac imaging successfully. However, Hybrid PET/MRI cardiovascular imaging will benefit from a prospectively-designed radio frequency (RF) phased array, that is able to minimize photon attenuation while maintaining high-quality and fast MRI images [1]. To our knowledge, the only two arrays used today for hybrid PET/MRI cardiovascular imaging are either incapable of achieving high acceleration or affect the PET photon count greatly. In this study, we examine and evaluate a pre-developed, PET/MRI - dedicated 32 channel RF resonator for cardiac imaging. The study compares the quality parameters of MRI parallel imaging, such as g-factor, noise correlation coefficients, and SNR, to the conventional arrays (mMR 12-channel and MRI-only 32-channel) currently used in hybrid PET/MRI cardiovascular imaging.

Methods: The quality parameters of parallel imaging were estimated for multiple acceleration factors on a phantom and three healthy volunteers. TrueFISP acquisition was used in this study, on both phantom and in-vivo. All MRI acquisitions were performed on a 3.0T Biograph mMR system (Siemens AG, Healthcare Sector, Erlangen, Germany). Noise correlation between channels of a phased array and the g-factor maps were estimated and analyzed for multiple acceleration factors based on the technique described in [1]. Using a Germanium-68 (Ge-68) phantom, preliminary measurements of PET photon attenuation caused by the novel array were briefly compared to the photon counts produced from no-array measurements.

Results: The global mean of the g-factor and SNRg produced by the novel 32-channel PET/MRI array were better than those produced by the MRI-only 32-channel array by 5% or more. The novel array has resulted in MRI SNR improvements of > 30% at all acceleration factors, in comparison to the mMR12-channel array. Preliminary evaluation of PET transparency showed less than 5% photon attenuation caused by both anterior and posterior parts of the novel array.

Conclusion: The MRI performance of the novel PET/MRI 32-channel array qualifies it to be a viable alternative to the conventional arrays for cardiovascular hybrid PET/MRI. A detailed evaluation of the novel array’s PET performance remains to be conducted, but cursory assessment promises significantly reduced attenuation.

[1] Nensa et al. (2018)
[2] Pruessmann et al (1999)