

Optimized Pediatric Suite with head array adjustable for patients 0-5 yrs of age

Modhurin Banerjee¹, Clyve Konrad Follante¹, Aleksey Zemskov¹, Rodney Bills¹, Mark Giancola¹, Lakshan Nanayakkara¹, Sarah Ortmann¹, Jessica Buzek², Taracila Victor³, Kolman Juhasz³, Stephen Scurria¹, Thomas Grafendorfer⁴, Paul Calderon⁵, Vijay Alagappan⁶, Steve Lee¹, Shreyas Vasanawala⁷, and Fraser Robb¹

¹GE, Aurora, OH, United States, ²GE, WI, United States, ³Vita-Mix Corp, OH, United States, ⁴GE, CA, United States, ⁵Diamante Engineering, CA, United States, ⁶Softgel Healthcare, TN, India, ⁷LPCH, CA, United States

Introduction: Currently, adult coils are used for pediatric imaging, which is suboptimal for a variety of reasons. For the pediatric population, a premium is placed on the ability to quickly obtain images and reduce or eliminate the need for sedation. The sensitivity pattern and g factor patterns for most adult coils simply do not lend themselves to the requisite high acceleration ability needed to quickly scan pediatric patients. Furthermore, adult coil systems are not optimized for workflow or other considerations for the pediatric population. Therefore, a significant need exists for a dedicated pediatric suite for whole body imaging.

It is desired that a pediatric suite offer minimum patient handling, light weight, ease of access/emergency egress, and repeatability of exams. In addition, most coils (and indeed, MR systems in general) can be visually intimidating to pediatric patients making scanning all the more difficult; as such aesthetics are an important attribute for any coil design.

Methods and Materials: This work represents the evolution of a 32 channel pediatric suite design (1,2). Said coil is able to serve as a whole body coil for the 0-5 y.o. pediatric population. One of the challenges of the peds population is that the head dimension varies greatly. An adjustable head coil was designed to eliminate multiple rigid coils offering a clear cost and work flow advantage. Also the head coil was designed to allow head immobilization along with easy access to patient head for intubation and the intubation tube. Similarly the torso dimension is adjustable too.

The 80 element suite consists of an adjustable 28 element head coil along with a 28 element uniform posterior array embedded in the rigid base. Two foamed anterior pieces are also present consisting of 12 or 16 element uniform arrays. The output for the 80 element coil is multiplexed down to 32 channels.

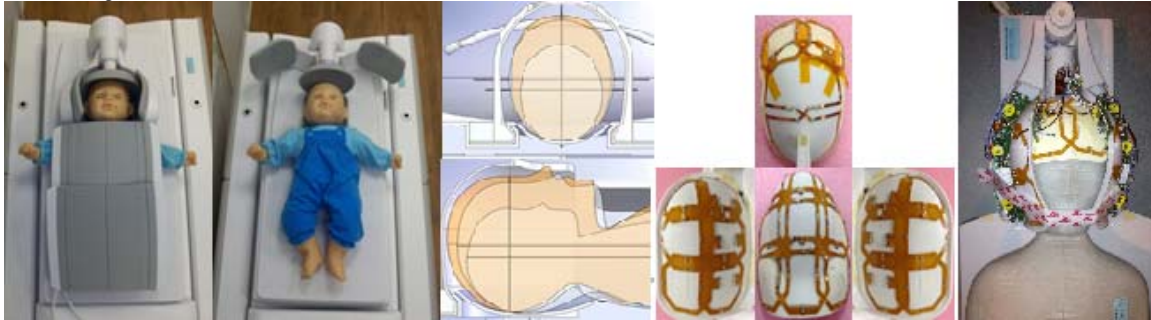


Figure 1: An illustration of the prototype concept coil, and as-built head arrays with SI and LR adjustability. The variations for the head dimensions along the SI, AP and LR directions from new born to 5 years of age are almost 6 cm; 4 cm and less than 3 cm (i.e 1.5 cm from each side) respectively. The torso the dimension varies from 10 – 25 cm along LR and 15 – 50 cm along SI direction from new born to 5 years of age (3).

Results: Via both simulation and experiment it was observed that uniform torso arrays have similar g-factors to that of the Invivo 32 channel Cardiac Coil.

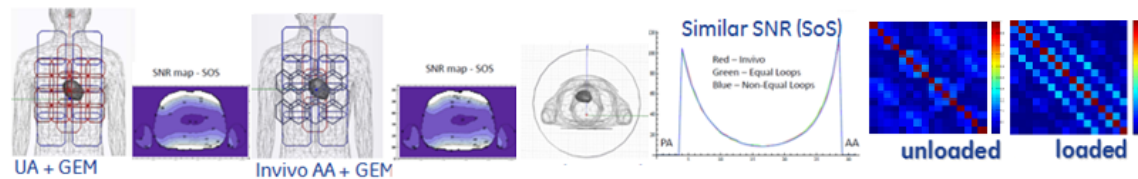


Figure 2: Simulated g-factor and SNR for uniform torso array, and Invivo Cardiac coils (left). Measured noise correlation magnitude for uniform torso array coil in unloaded and loaded conditions.

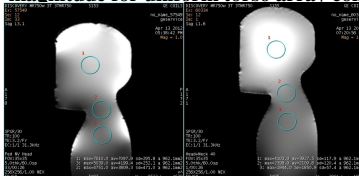


Figure 3: Phantom testing for peds head coil was done using 3T GE DVw scanner and a SPGR sequence (TR/TE = 100 ms/3.2 ms; 256*256; FOV = 35cm) and a SOS reconstruction for 2 months and 5 years old pediatric phantoms. Fig. 3 is a comparison of the SNR performance of 28 channel peds head coil to 32 channels GEM HNU coil. The peds head array outperforms the GEM HNU, offering a nominal 25% SNR performance increase at the center and overall SNR improvement of 50%.

Conclusions: In this work we have created a pediatric suite, 32-channel array for whole body imaging that has an adjustable 24 element head array and anterior and posterior uniform arrays of 28 elements each. This unique head coil design demonstrates a significantly higher SNR than the GEM HNU head coil for peds head imaging and equivalent SNR compared to 32 channel Invivo cardiac coil for torso imaging.

Acknowledgment: The authors want to thank State of Ohio for their important contribution through Ohio Third Frontier Grant that led to successful completion of the work.

Reference:(1) Zhang T, et al., *Clinical performance of contrast enhanced abdominal pediatric MRI with fast combined parallel imaging compressed sensing reconstruction*. JMRI Oct 2013. (2) Modhurin Banerjee, et al., *The Dual Purpose CAPTAIN Coil*, ISMRM 21st Annual meeting. (3) Heike E. Daldrup-Link and Charles A. Gooding, *Essentials of Pediatric Radiology*, Cambridge Univ. Press. (4) US Patent US 20130076358 “Adjustable MRI head coil apparatus and MRI system.”