A Novel Head/Neck Coil Design Using Matrix Clusters And Mode Combiners

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Introduction:

A novel approach to parallel imaging arrays for the head and neck region is presented.
The so called head and neck "Matrix Coils" consist of several clusters of linear polarized (LP) elements which are combined via "Mode Matrix" combiners to form an equal number of mode signals which allow a scalable use of receiver channels as a function of acceleration factor and/or peripheral SNR.

Methods:

The complete head/neck matrix consists of 16 independent array elements.
The head matrix consists of 12 independent array elements which are grouped in 4 clusters with 3 elements each (Fig.1a). Each cluster is connected to a Mode Matrix which combines the original 3 LP signals to a new set of 3 "mode signals". The primary mode signal is equivalent to a CP signal created by using optimum Roemer weighting factors for a given target region - in this case the center of the head [1-2]. The secondary mode signal is chosen in such a way that in combination with the primary mode signal, best results for left-right acceleration at a factor of 2 can be achieved [3-8]. When using a combination of all three mode signals, i.e. "Triple Mode" operation, the cluster behaves as if the original LP signals are fed into the receivers without prior combination. The "Triple Mode" is useful for acceleration factors 2 or 3 in left-right direction and/or for obtaining even higher SNR outside the primary target location.

The 4 LP neck elements are grouped in 2 clusters with 2 elements each (Fig.1b). Each cluster is connected to a 90° hybrid which creates forward and reverse CP mode signals. The forward CP mode signal is the primary mode signal and equivalent to a optimum Roemer weighted signal with respect to the center of the neck. The combination of forward and reverse CP mode signals contains the same information as the original LP signals.

Since the Mode Matrix combiners can be regarded as invertible signal transformation matrices, using the full set of mode signals is equivalent to using the full set of original LP signals. However, only 6 "mode signals" from the mode matrix are necessary to achieve maximum SNR at the center head/neck region. The additional 12 signals can be used for higher acceleration factors or to improve SNR in the periphery.

Results and Conclusions:

Comparisons between the full 16 channel array without mode combiners and the scalable head and neck matrix coils with combiners were done. When using only the basic 6 CP mode signals, the matrix coils already achieve the maximum SNR at the center of the head and neck. Using the additional 12 signals improves the SNR in the periphery or allows to use higher acceleration factors in left-right and anterior-posterior direction.

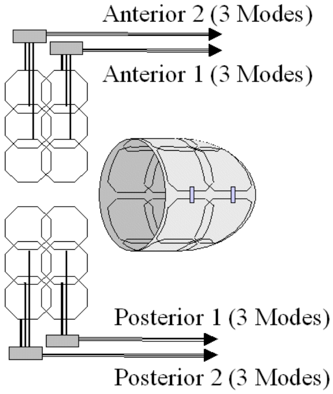

Fig. 1a: Head Matrix layout with clusters and combiners.

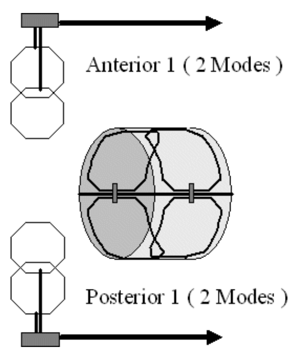

Fig. 1b: Neck Matrix layout with clusters and combiners.

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