An 8 Channel Geometry Optimized RF Coil Array for Imaging of Fish at 3T

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Introduction

The aim of the Digital Fish Library (DFL) project (http://www.digitalfishlibrary.org) is to acquire high resolution MR images of (preserved) specimens in the Marine Vertebrates Collection (MVC) of the Scripps Institution of Oceanography (SIO). A major difficulty in imaging fish is that, unlike mammalian organisms typically used in MR studies, fish have evolved into a wide variety of shapes, and thus have aspect ratios that do not load optimally with existing radio-frequency (RF) coils. In particular, many fish of interest in this study are elongated and laterally flattened, and thus an RF coil designed to more closely conform to such shapes would constitute a highly non-standard RF coil design. While small RF coils that accommodate non-standard shapes are relatively easy to construct, this is not the case for larger array coils that are needed to achieve high SNR and proper coverage in larger specimens. To accommodate the large number of specimens to be imaged as part of the DFL project we plan to build a series of unique ``fish coils'' that are elongated and elliptical in cross section in order to provide more optimal coil loading and thus greater SNR for such specimens. We present here the design and construction of the first of these designs and show initial results in a specimen.

Coil Design

The fish coil specifications were met by configuring eight overlapped 10 cm by 42 cm rectangular loop structures formed with 6 mm wide copper segmented strips on a thin custom oval shaped 16 cm by 20 cm by 54 cm long elliptical fiberglass tube with one of the long arms of each loop solder slide adjustable for optimal adjacent loop decoupling (**Figure 1**). Additional loop decoupling was provided by a balanced current block decoupling feed for each loop through an impedance transform balun to 50 ohm coax for coupling the high impedance impressed proton signal voltage on the loop to the low noise amplifiers (1-3). Passive detuning during transmit was also included on each loop in addition to the active PINs (**Figure 2**). The interface to the GE 3T system was accomplished by converting a standard GE 8 channel head coil cable to provide fan out of all channel coax lines to our custom LNAs built for this application (**Figure 3**). The modification of the GE cable included making a special PC board to replace the original one so that series current limiting power resistors could be mounted conveniently to drive both the internal TR PINs in the LNAs and loops and to provide the attachment of interface of the coax lines.

Results

Sections through a 3D image of *pseudopriacanthus serrula*, or popeye catalufa are shown in Figure 4. This image was acquired using a 3D balanced SSFP sequence with a resolution of 0.9x0.9x0.7mm^3 in an acquisition time of approximately 4min. The dark band towards the posterior of the fish is a resonance offset related null that is characteristic of balanced SSFP.

Conclusion:

This coil is the first of a series of dedicated fish imaging coils that will allow for time efficient high resolution cataloging of the anatomy of the extensive and unique fish collection of the SIO. It combines the use of coil arrays, preamplifier decoupling, and a unique geometry.

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References

[1] Roemer et al, MRM 16, 192-225 (1990)
[2] Meck et al, RSI 72(11) 2001
[3] Tobgay, PhD Thesis, Worcester Polytechnic April 2004

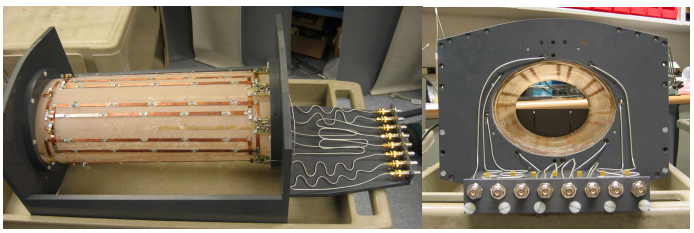

Figure 1

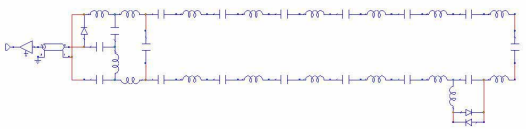

Figure 2

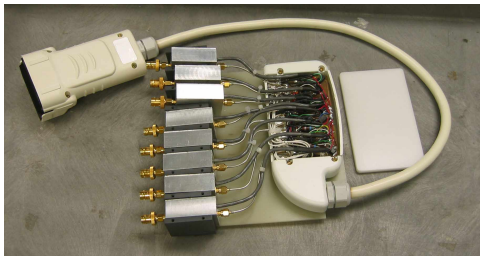

Figure 3

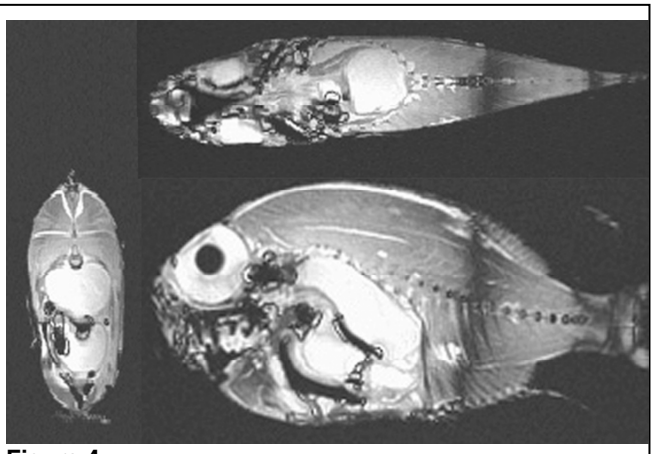

Figure 4.