Digitally Manufactured, Highly Conformal Receive Arrays

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Motivation

- Typical MRI coil arrays are designed to fit 99% of the population.
- A closely fitting coil improves SNR, increases comfort, and permits more acceleration[1].
- Custom coils are performant but require a trained RF engineer and months to build.
- We propose a scalable manufacturing technique that produces highly conformal coils rapidly.

Methods

Construction

- Silver conductive ink is sprayed onto a flat polycarbonate sheet[2].
- The sheet is vacuum formed over a mold of the desired anatomy.

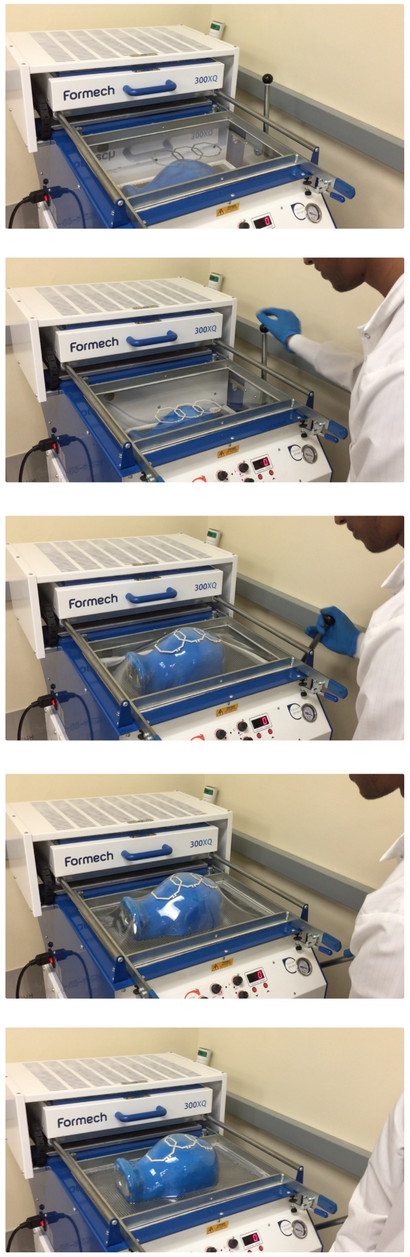
Electroless Plating

- Printed structures are plated with copper to improve conductivity[3].
- Plating is isotropic and fills in cracks.

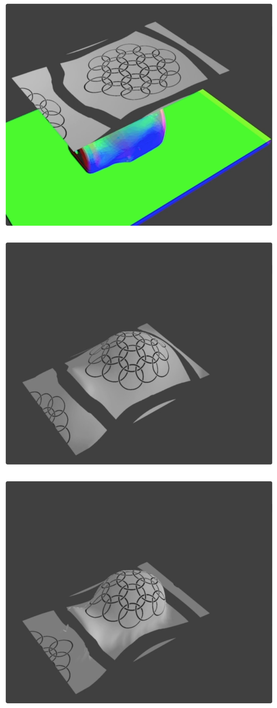
Simulation

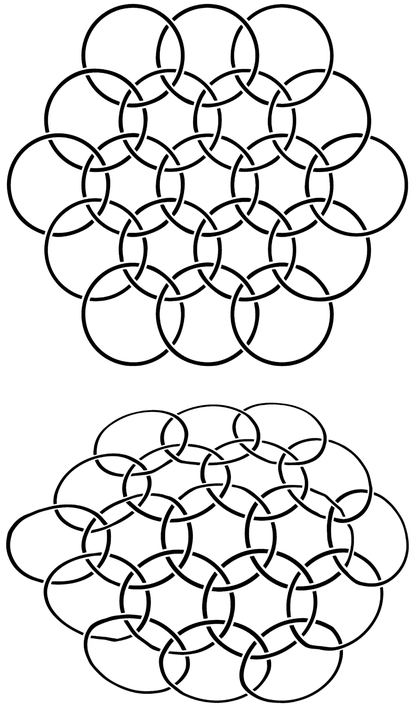
- Developed a graphical simulation to pre-distort printed patterns before vacuum forming.
- Written in C++. Utilizes Embree[4] (collisions), CGAL[5] (UV mapping), and OpenGL

Vacuum Forming

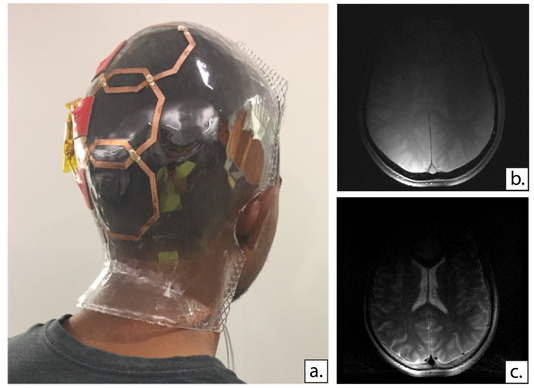


Simulation



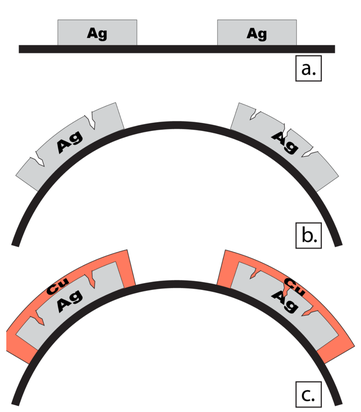


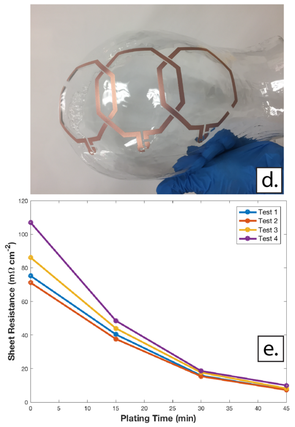
Results



- Prototype array with 3 octagonal, 8 cm elements. Tuned to 123.25 MHz.
- Poor unloaded Q (~40) due to low plating time.
- Scans preformed on Siemens 3T Trio. b. GRE (TE: 10, TR: 438, 0.6 x 0.6 x 5 mm^3) c. TSE (TE: 112, TR: 3490, 0.6 x 0.6 x 5 mm^3).

Electroless Copper Plating





Conclusion / Discussion

- Printed three-dimensional coils show promise for increased SNR, improved patient comfort, and better motion restriction.
- Process allows rapid production of coils in a wide range of sizes.
- Could make custom coils for niche applications (MR guided therapies, fMRI studies).

References

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2. Corea, Nature Comm., 2016
3. Kao, Electrochem., 2007
4. Wald, ACM TOG, 2014
5. Liu , Comp. Graphics, 2008

Acknowledgements

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