Comparing Printed and Milled Patch Antenna at 10GHz

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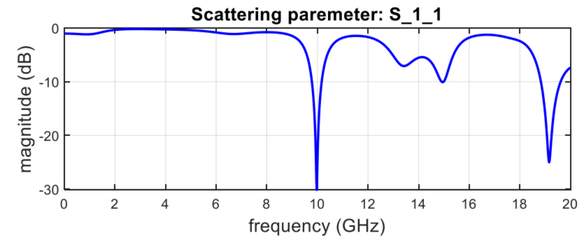
Introduction

- Conformal (Flexible) antenna have many useful applications in chipless RFID, health monitoring sensors, and placing antenna on curved surfaces
- A microstrip line-fed patch antenna was designed for 10GHz operation and fabricated using two different methods: milling and printing
- The design was simulated using the FDTD software package, CEMS
- The milled antenna was created on 1.6mm thick FR4 with 1oz copper using an LPKF ProtoMat
- The printed antenna was created on 125 µm thick Kapton in silver nanoparticle ink. It was then attached to a 1.6mm thick, single-sided piece of FR4 to serve as a substrate and a ground plane
- The reflection coefficient S_{11} was measured for the simulated, milled, and printed antennas.

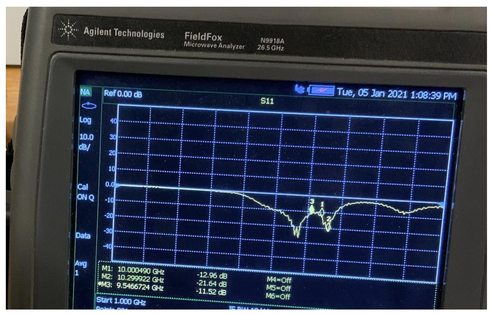
Simulation Results

- Simulated S_{11} of the antenna showed that the antenna was most resonant at 10GHz
  - -10dB is considered matched
  - >-20dB is ideal
- The simulation assumed the following properties (top):
  - ε_r=4.4
  - 1.6mm thick FR4
- Parameters were redetermined based off milled antenna measurements (bottom)
  - ε_r=~4.15
  - 1.45mm thick FR4



Measurement Results

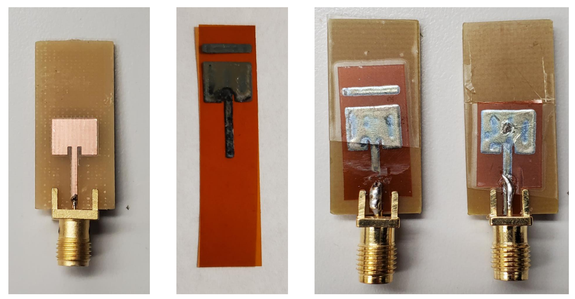
- S_{11} Measured of all antenna
  - Left to Right: milled, printed
- Milled Antenna best resonance at 10.3 GHz
- Printed Antenna has S_{11} of-8.9 dB at 10GHz
- Printed Antenna poorly matched compared to simulated or milled antenna
- Printed Antenna is significantly more lossy at all frequencies compared to milled and simulated antennas
  - Likely due to curing method



Conclusion and Future Work

- Conclusions
  - FR4 used has different ε_r than expected
  - Printed antenna appears very lossy, must improve in future designs
- Future Work
  - Find way to better attach connectors to printed antenna
  - Contact manufacturer/KAUST to try and reduce resistive losses for the ink used
  - Measure far field and compare it with simulation results.
- Skills Gained:
  - DMP-2850 Materials Printer operation
  - LPKF Mill operation
  - Antenna Reflection Measurements
  - Use of Antenna design software

Fabricated Antenna



References and Acknowledgements

- Acknowledgements:
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