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**Proceedings Paper:**

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# Analysis of a Hybrid Broadband Reverberation Chamber Antenna

I. D. Flintoft, G. Esposito, A. C. Marvin, L. Dawson,  
M. P. Robinson & J. F. Dawson

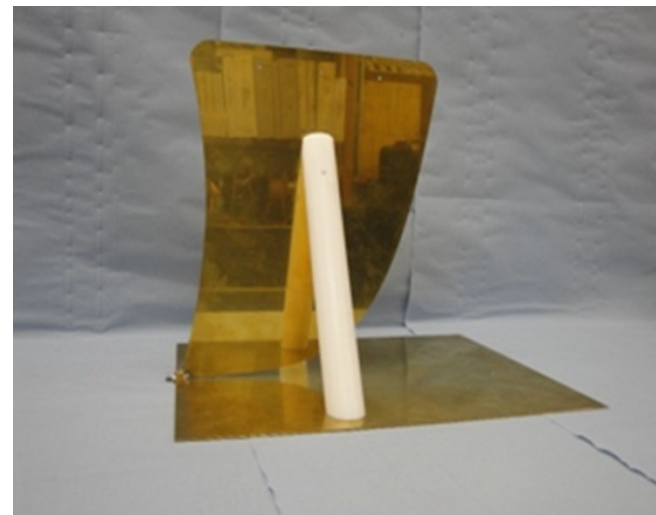
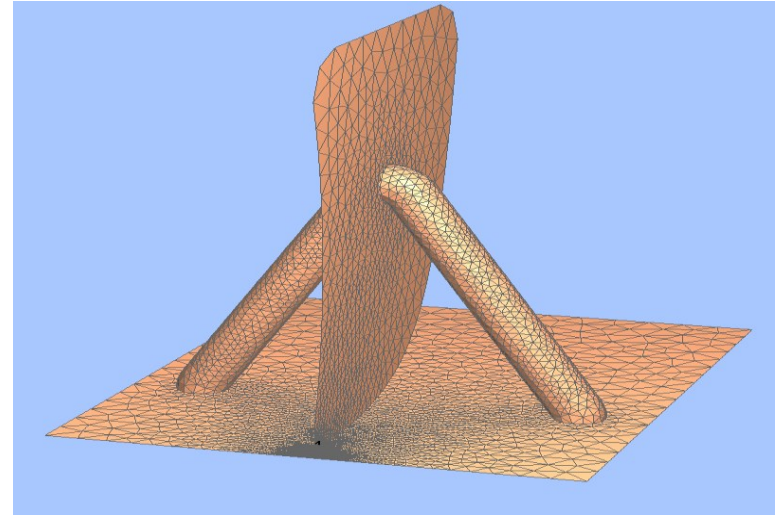
Department of Electronics, University of York, UK



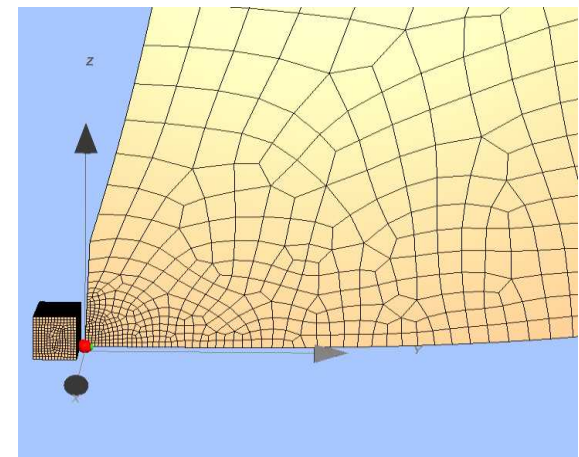
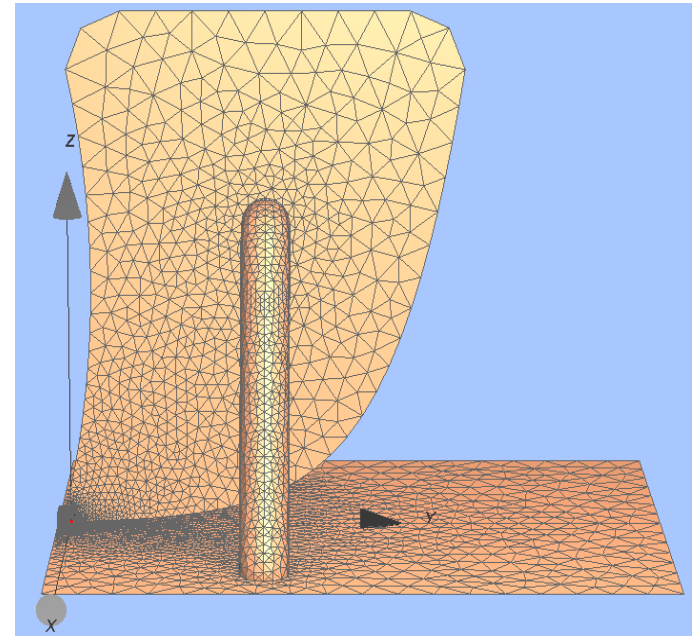
- Our aim was to produce an antenna for use in a reverberation chamber over a wide frequency range.
- Specifically the antenna should be usable in our chamber (4.8m x 3.3m x 2.2m) over the frequency range 200MHz to 20GHz.
- As with any linear structure its frequency range can be adjusted by dimensional scaling

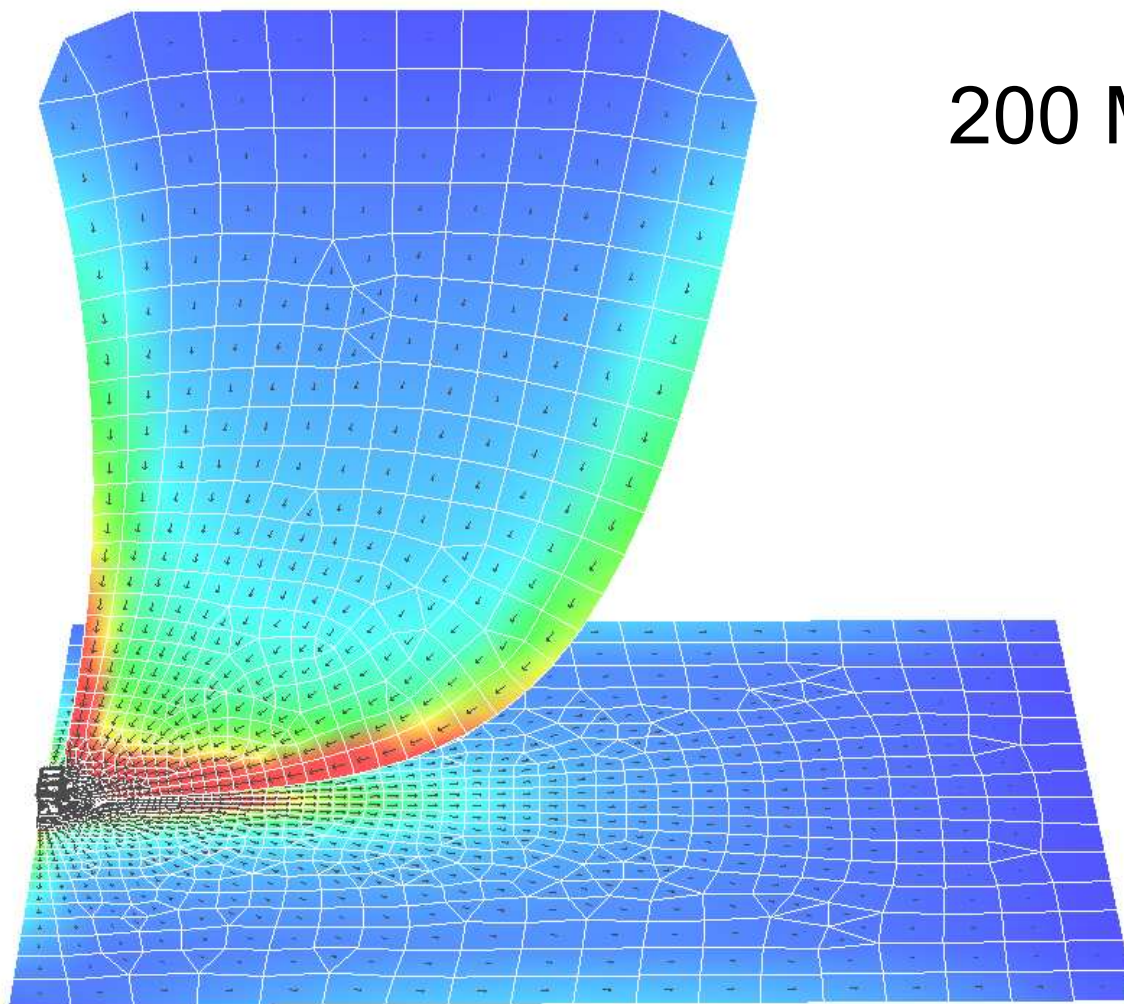
- Frequency range defined by input reflection coefficient:
  - $|S_{11}| < 0.316$  (-10dB) 200MHz – 20GHz
- Radiation pattern:
  - Not specified (isotropic in RC)
- Efficiency:
  - Maximised
- Size:
  - Minimised

- A hybrid monopole-exponential taper (Vivaldi) structure.
- Height 305mm.
- Ground plane width 300mm.
- Ground plane length 375mm.

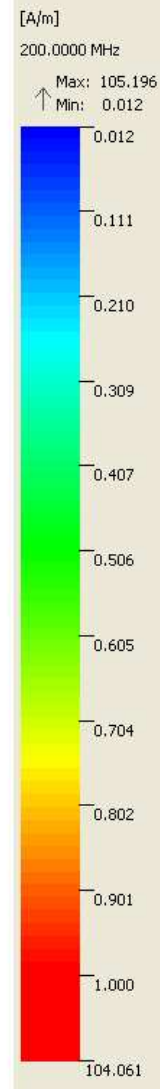


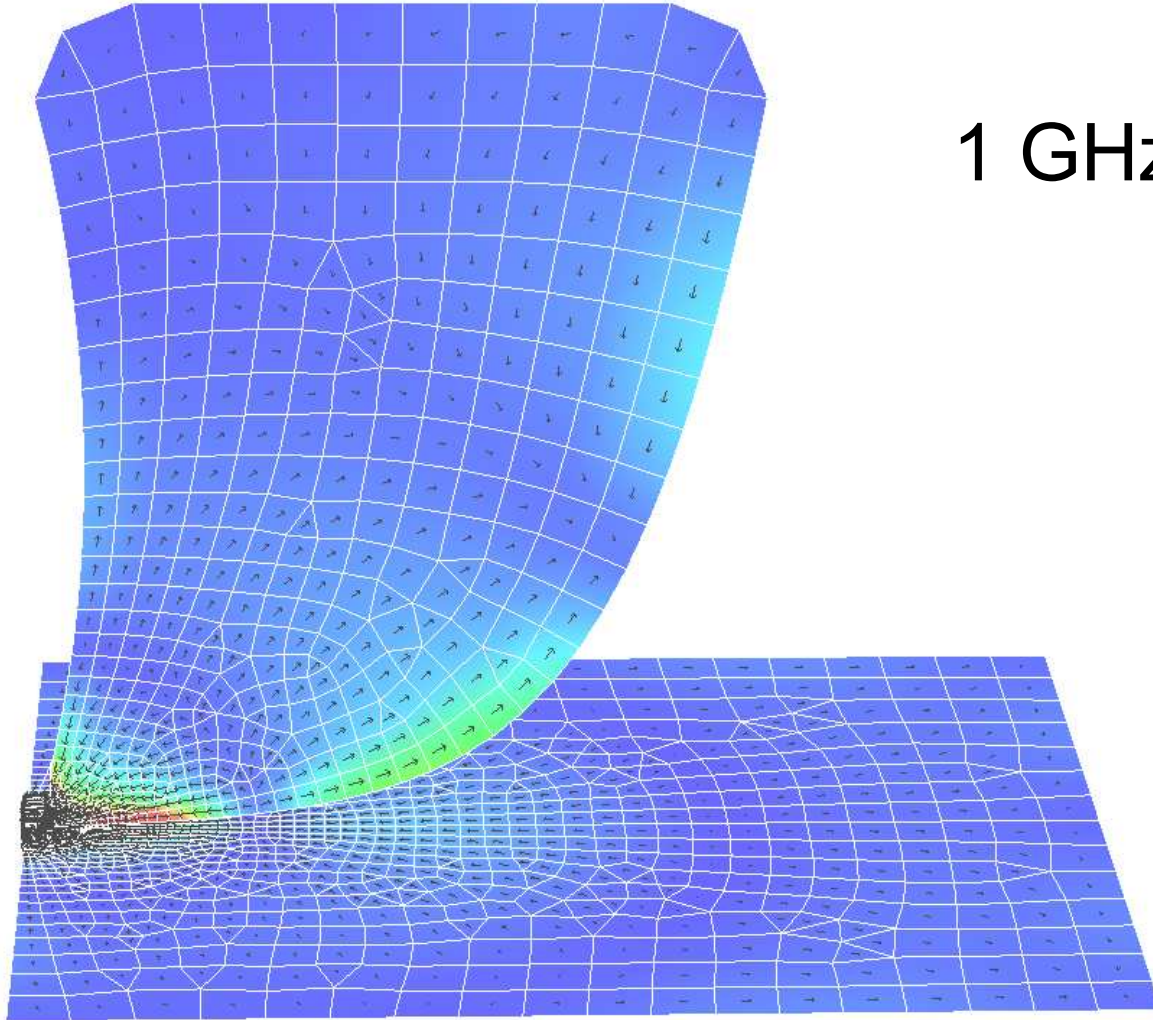
- Low frequency monopole resonant at  $\sim 250$  MHz.
  - Determined by the effective minimum length of the monopole defined by the curved edge above the feed point.
- Simple exponential taper from 400 MHz upwards
- The key is that the taper takes over before the  $\lambda/2$  anti-resonance of the monopole at  $\sim 500$  MHz



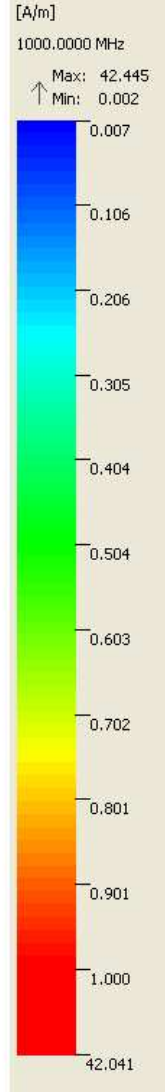


200 MHz



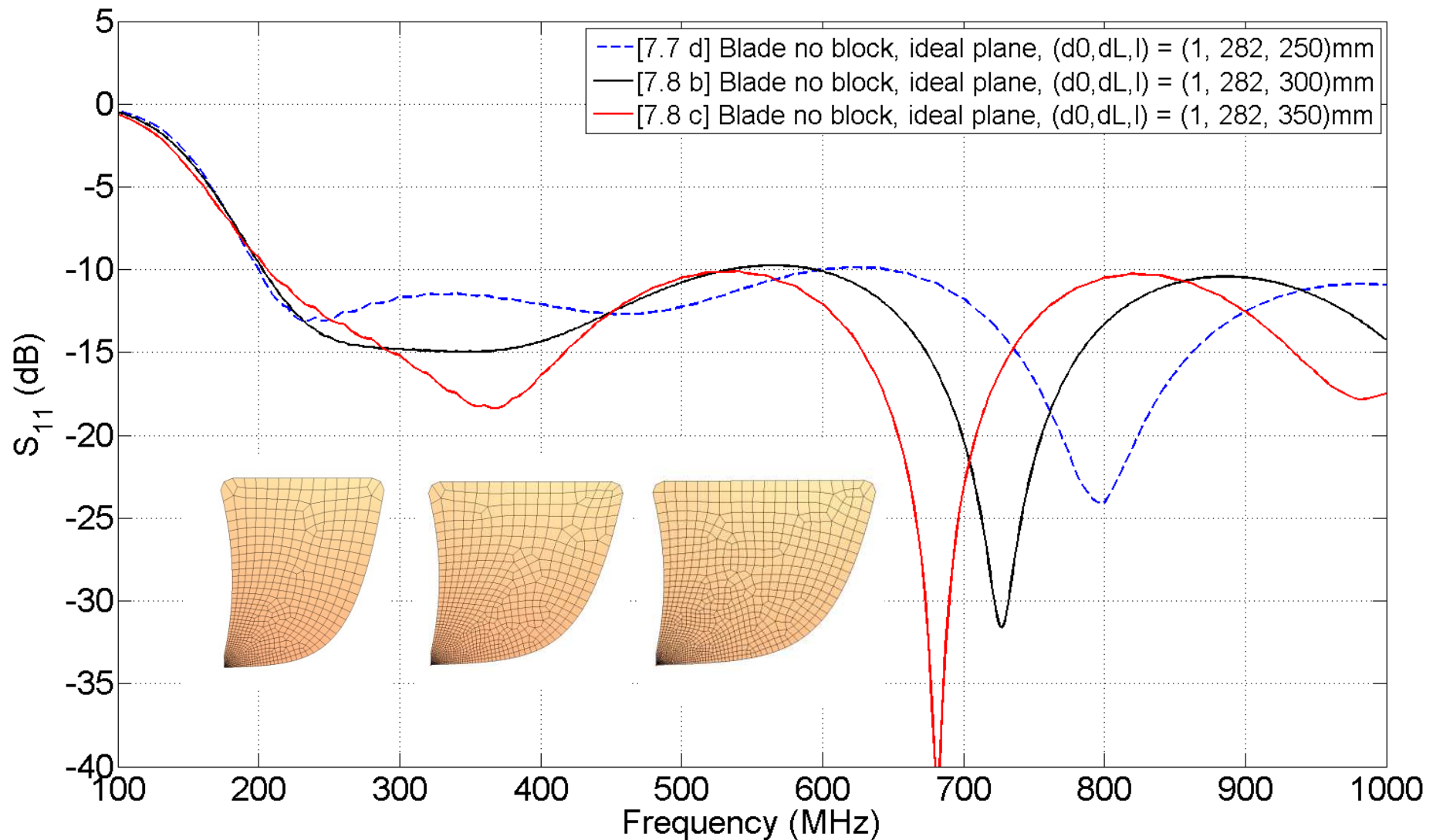


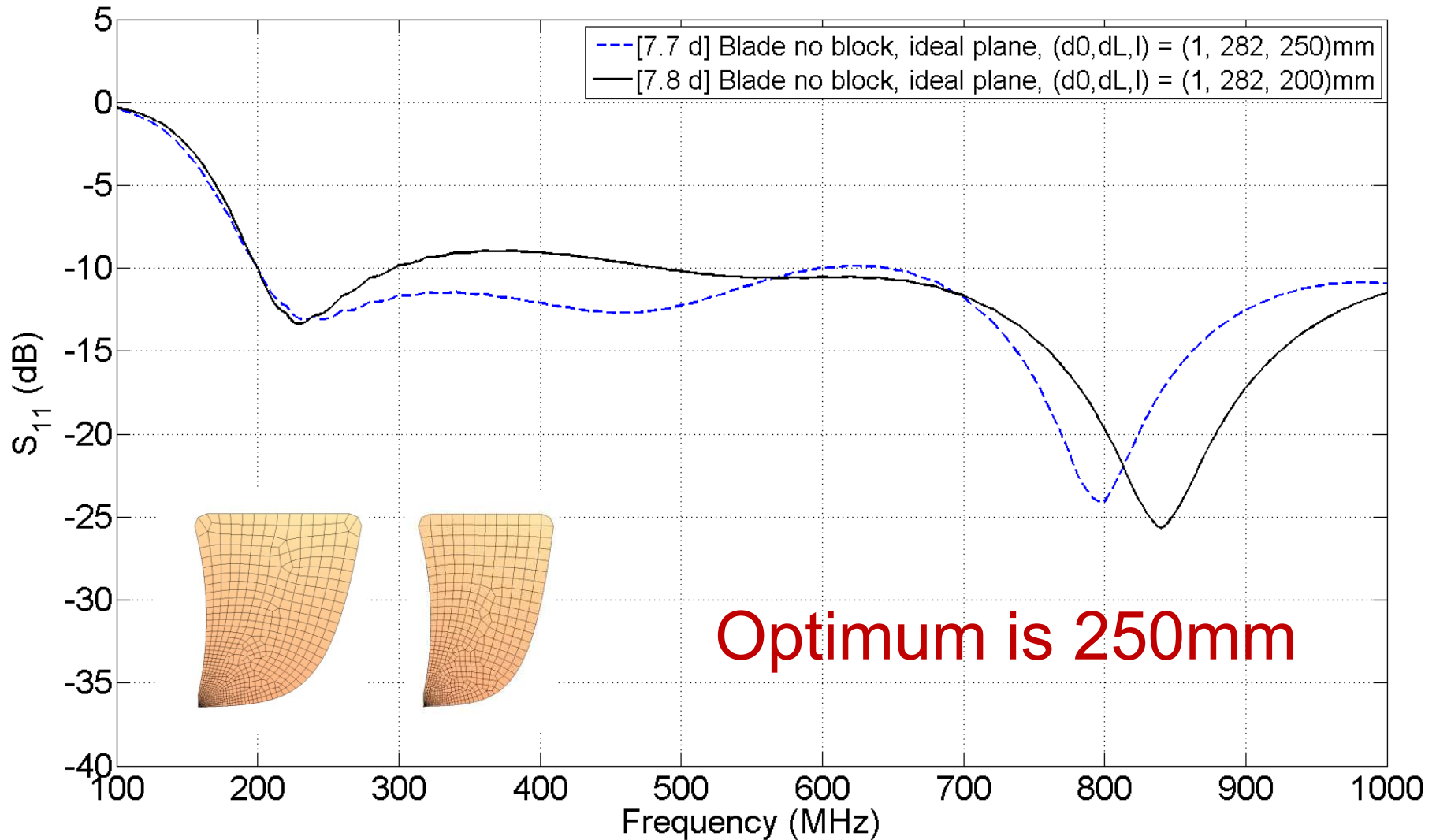
1 GHz

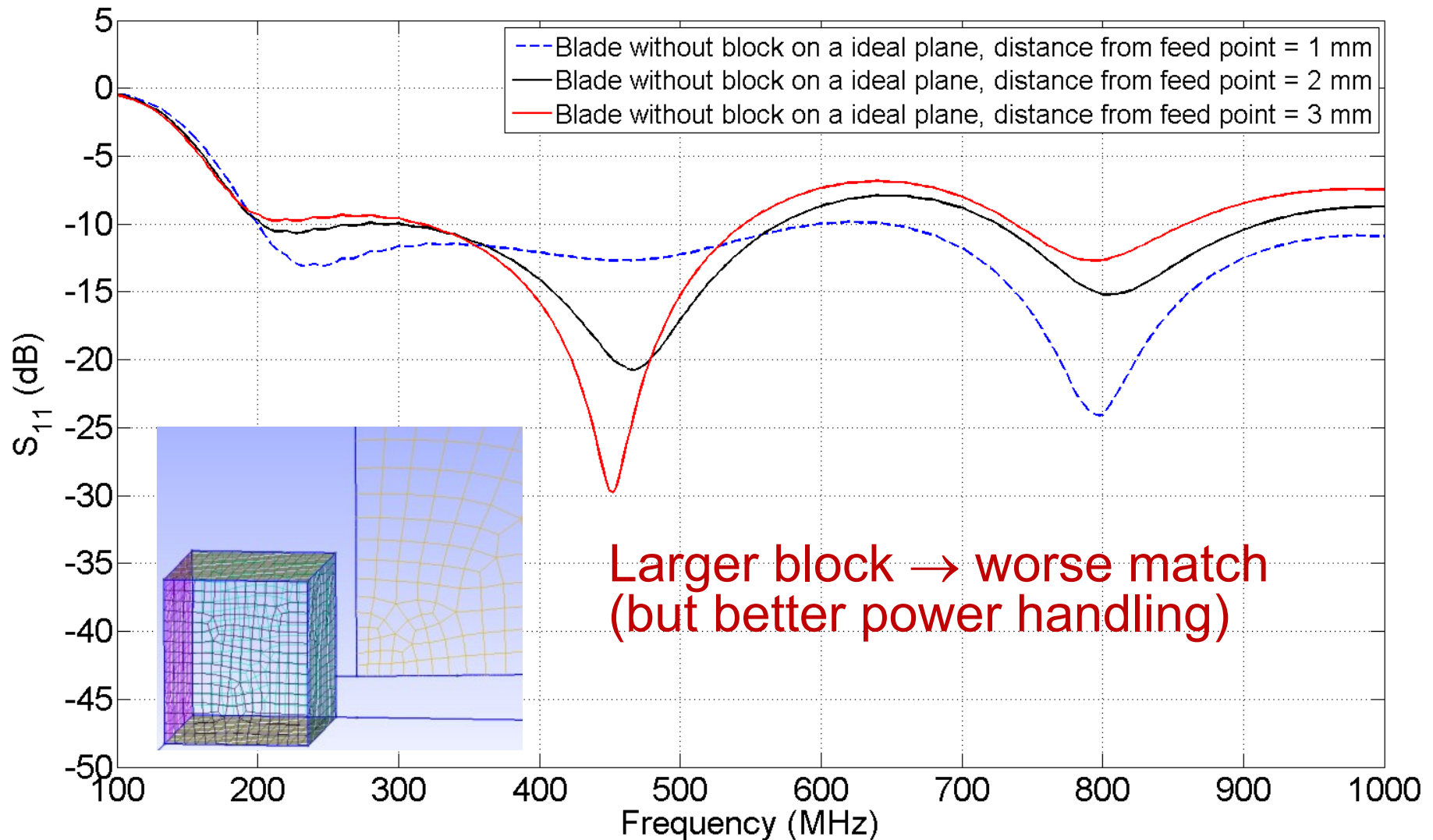


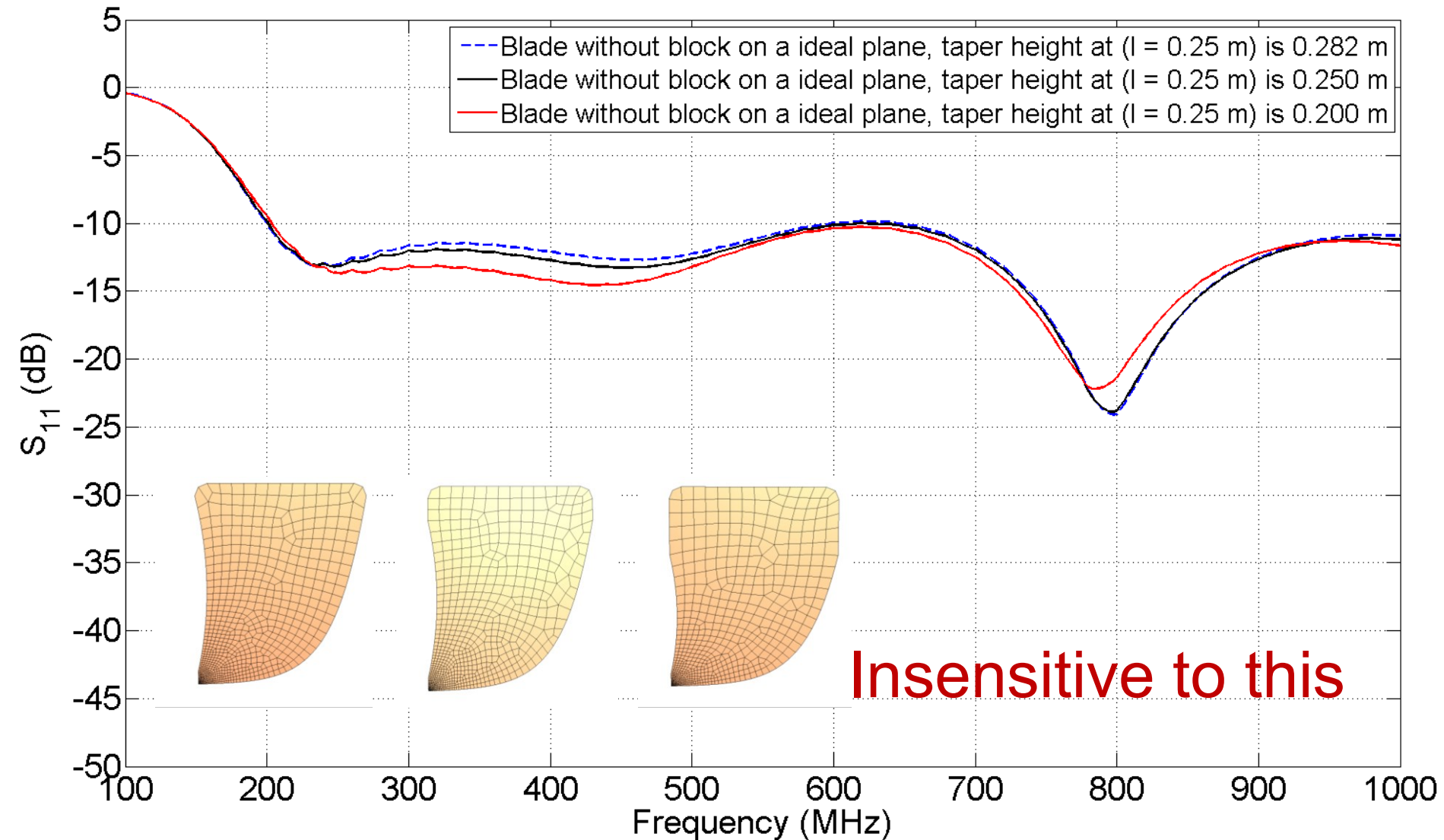


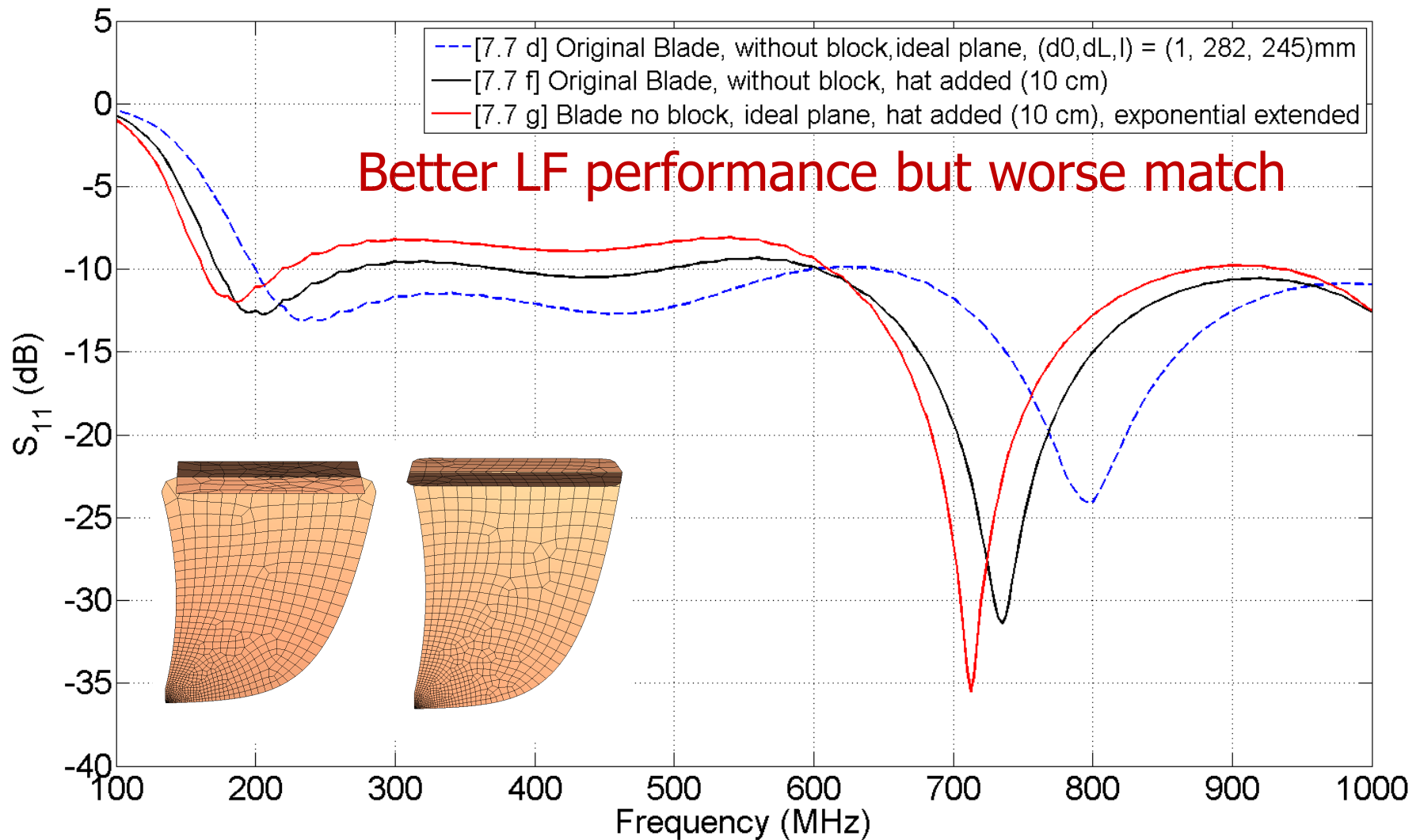
- Modelled with CONCEPT II and Gmsh
- Target:  $S_{11} < -10\text{dB}$  from 200 – 1000 MHz
- Radiation pattern less important for use in reverberation chamber
- Vary parameters including length and shape of exponential taper, and size of feed block
- Mesh size  $\sim 1$  cm at edges away from feed and  $\sim 0.5\text{mm}$  near feed

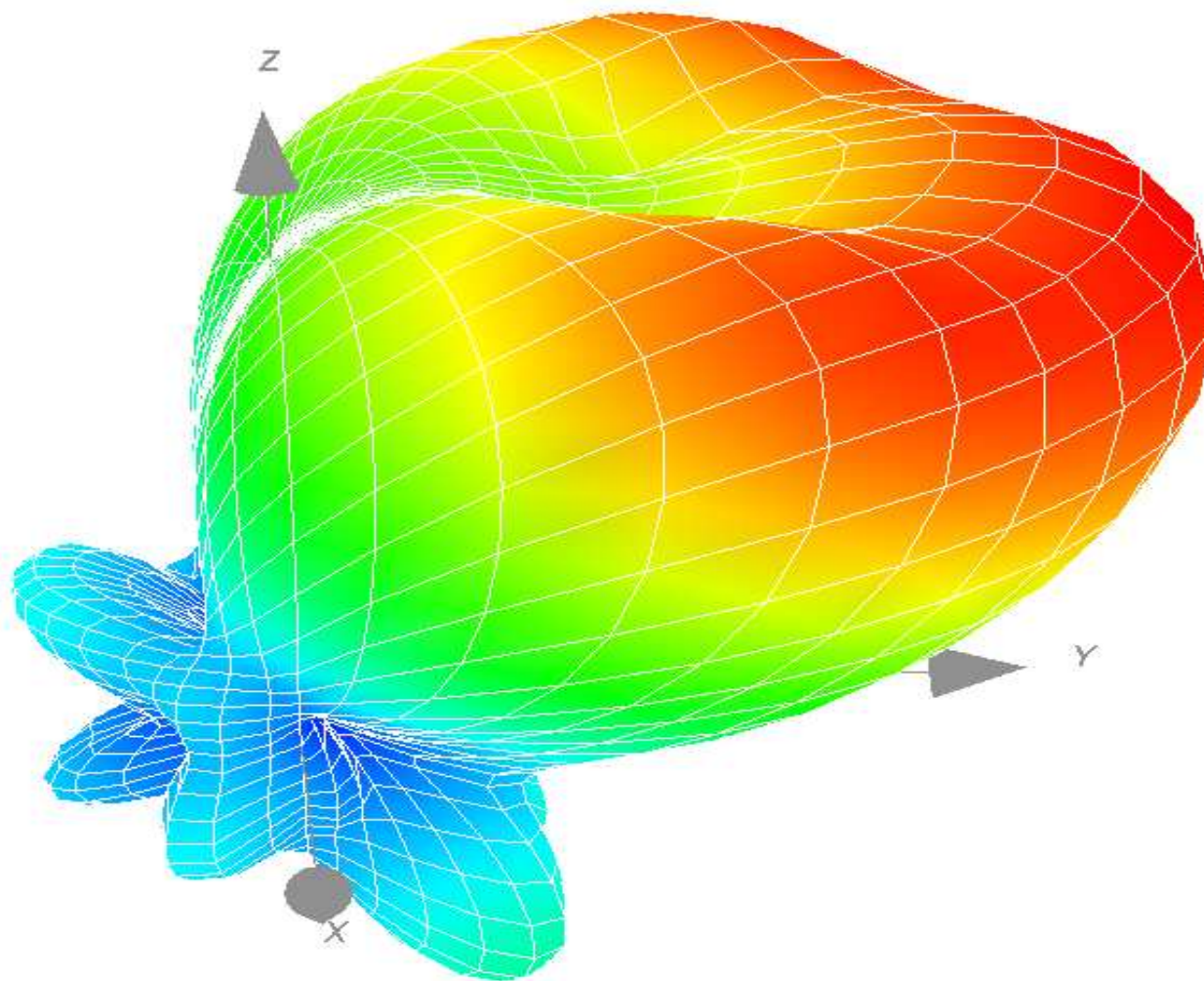




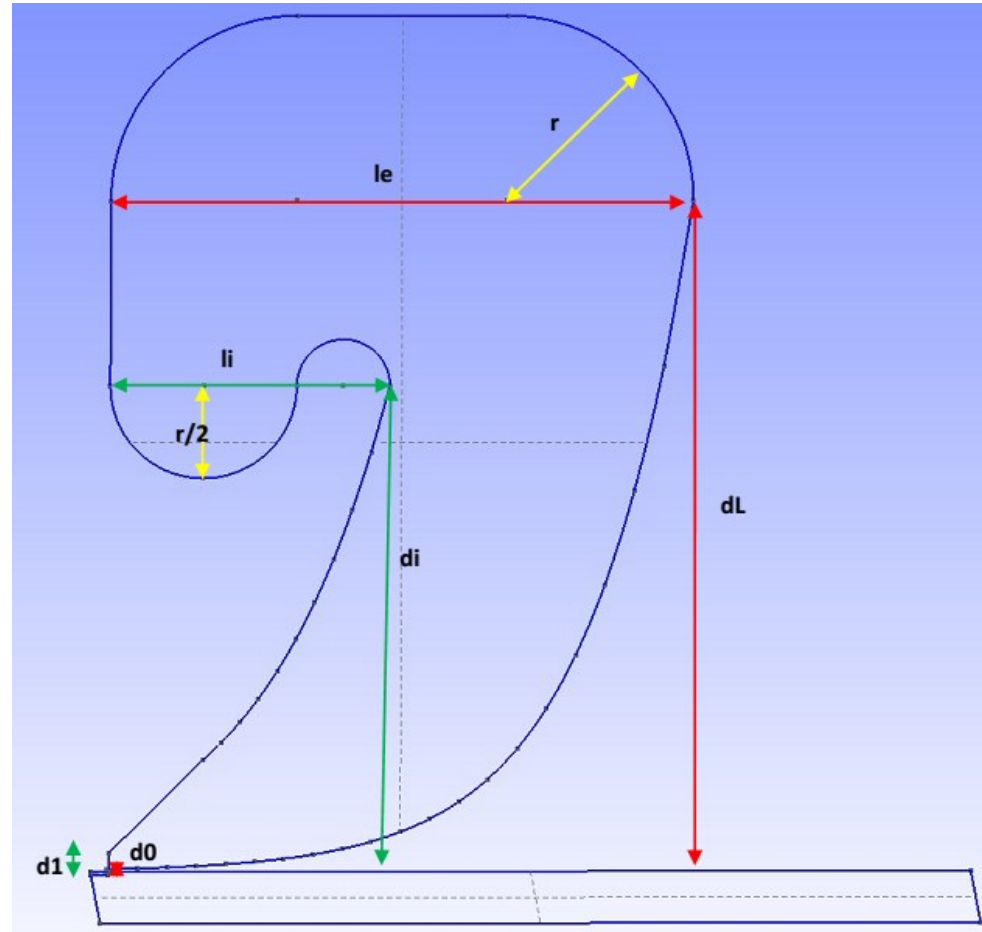






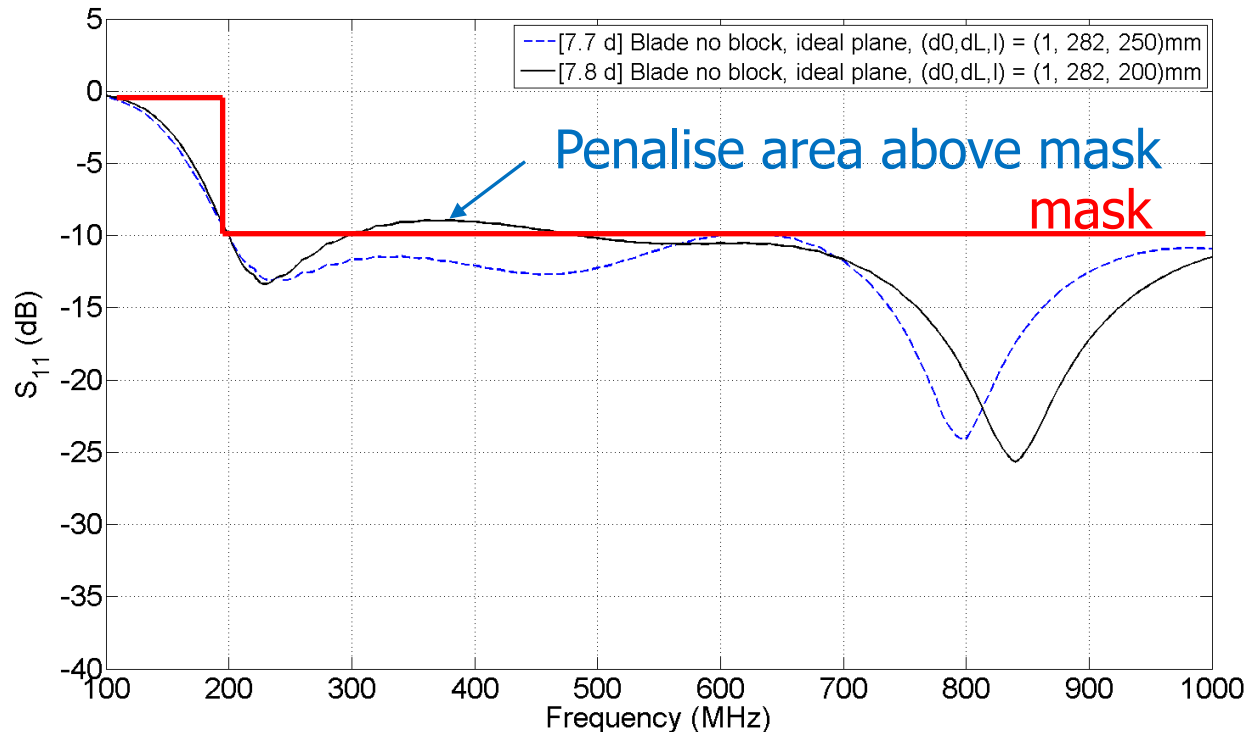


- Automatic optimisation
- Octave/MATLAB program
- Parametric CAD – Gmsh
- MATLAB GA toolbox or in-house Octave GA
- MATLAB/Octave functions to write CONCEPT input files

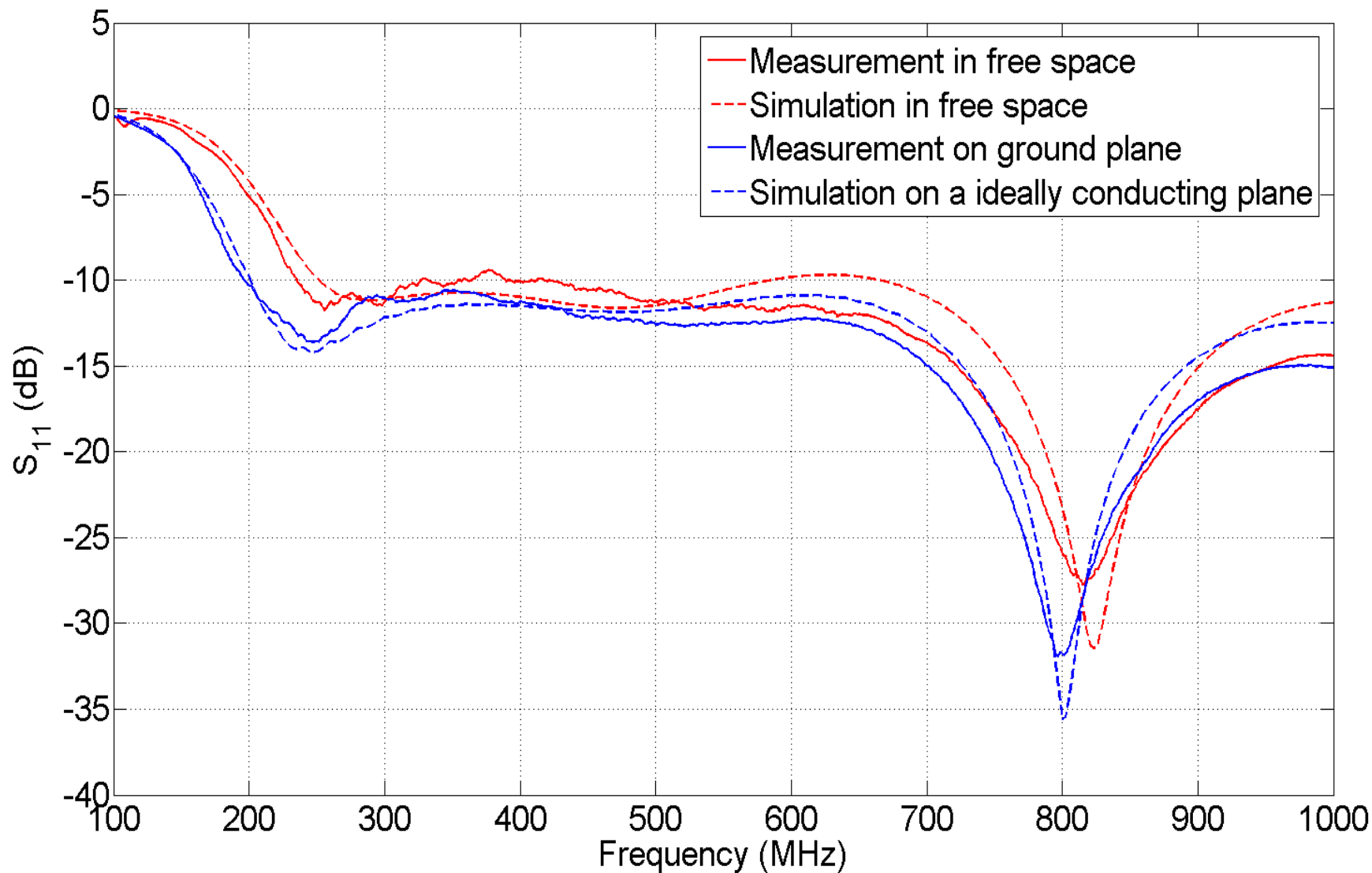


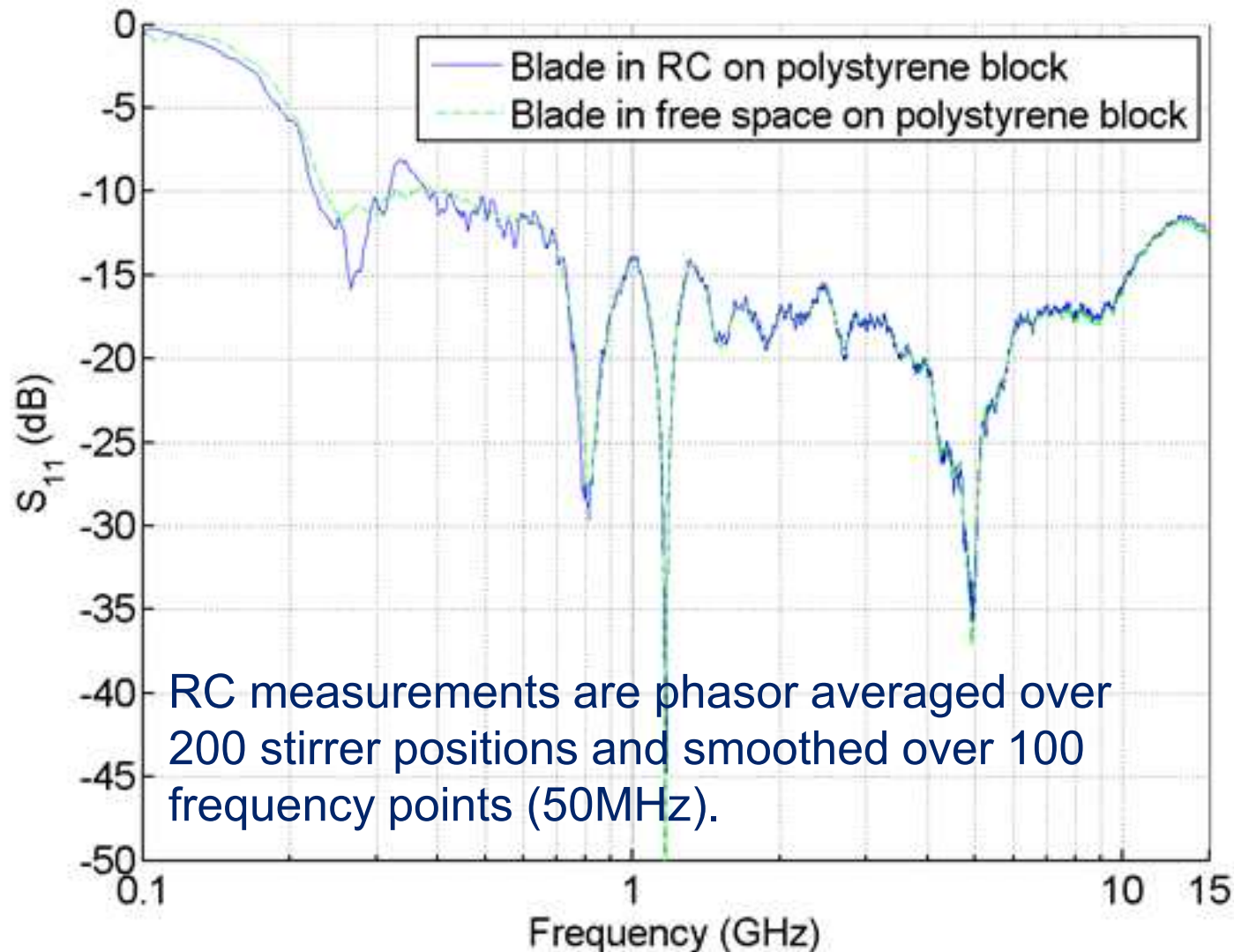


- Decode genotype -> parameters
- Create Gmsh (.geo) file with required parameters
- Create mesh using Gmsh
- Create CONCEPT input files from templates
- Run CONCEPT
- Post- process to get input impedance
- Evaluate cost function as area between  $|S_{11}|$  and upper mask

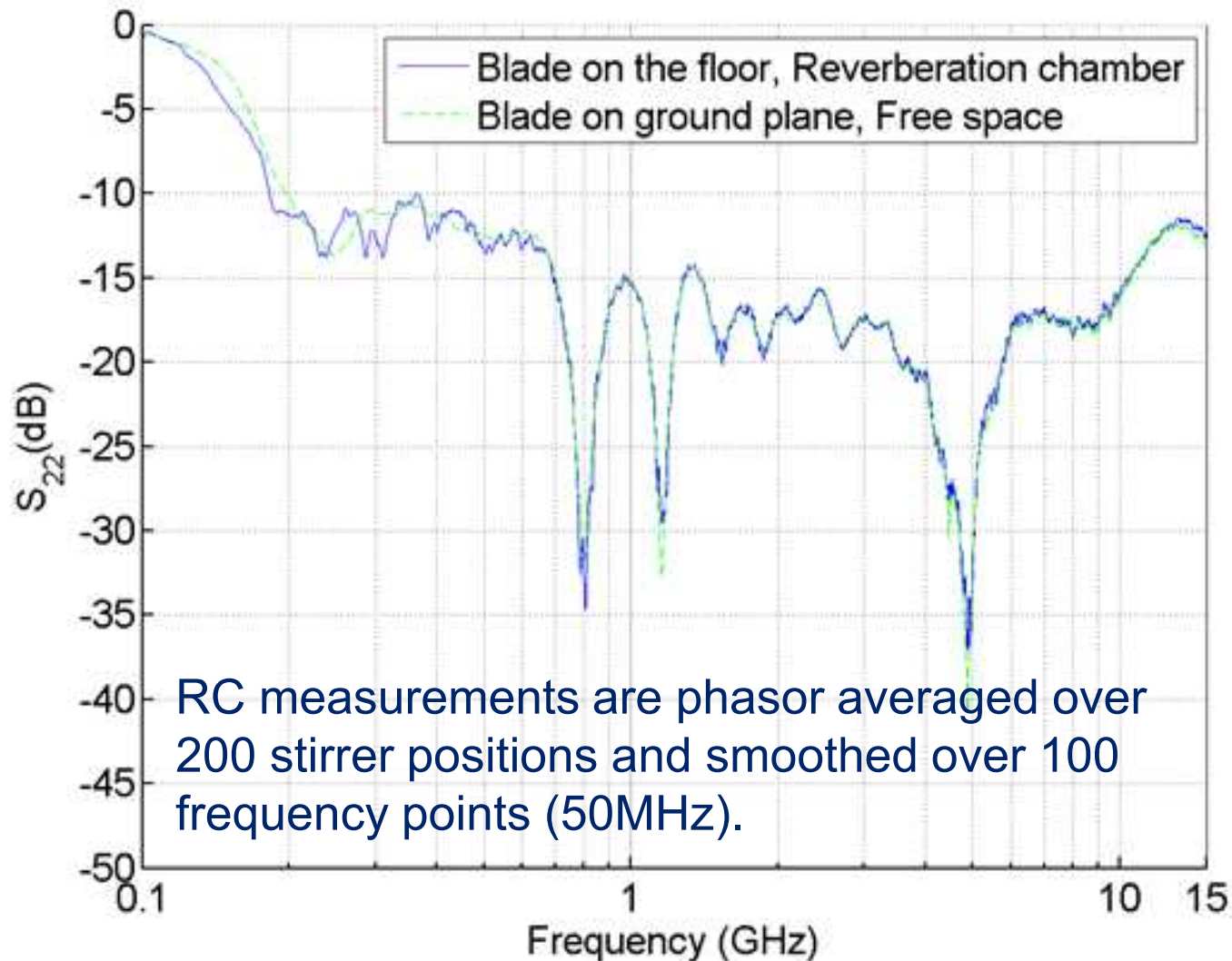


- Optimise cross-over region (monopole-> taper)
- Cost function is area between  $S_{11}$  amplitude mask and simulated  $|S_{11}|$ .





RC measurements are phasor averaged over 200 stirrer positions and smoothed over 100 frequency points (50MHz).



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- Successful transition between antenna modes
- Initial design was close to optimal!
- Trade-offs:
  - Feed point:  $S_{11}$  against power handling
  - Top loading:  $S_{11}$  against LF performance
- Final antennas have acceptable performance from 200 MHz to 25 GHz ( maybe higher)