A printed LPDA antenna with improved low frequency response

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Who are we ?

University of HUDDERSFIELD
Inspiring tomorrow's professionals

- **STAR** (**S**ystems, **T**elecommunication and **A**ntenna **R**esearch) group at the University of Huddersfield

RESEARCH AREAS:

- Antenna Design
- 5G communications
- UHF 4K TV Broadcasting
- Wireless Sensor Networks
- Radio planning

Problem Statement

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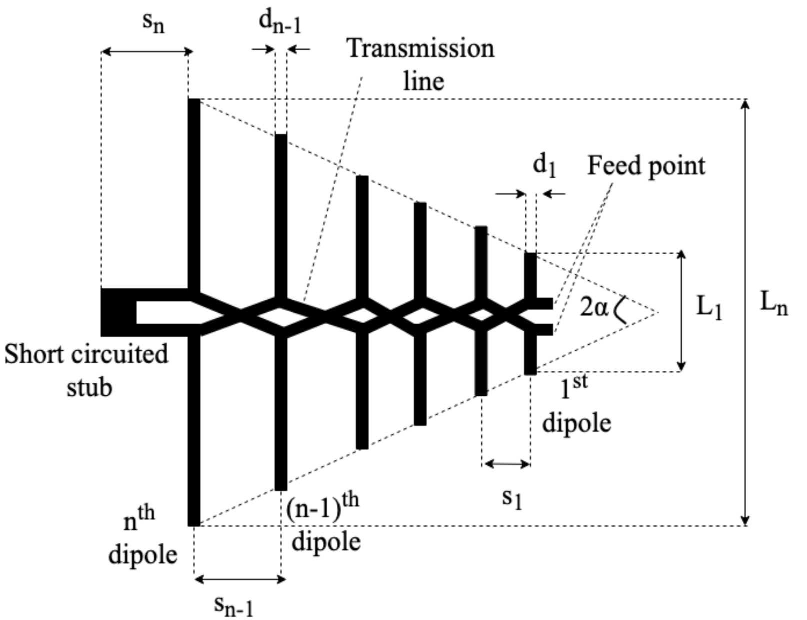
- To design an antenna that operates from 400 MHz to 8 GHz .
- Conventional log-periodic dipole array (LPDA) antennas are good candidates to achieve such a wide bandwidth.
- However, they are bigger in size and therefore there is a need to reduce the size of such antennas for various applications.
- Printed-LPDAs (PLPDA) significantly reduces the antenna dimensions.
- The proposed technique in this paper further reduces the size of conventional PLPDA.

Design approach

- Initially, the dimensions for 25-dipole LPDA is calculated using conventional LPDA design equations to obtain approx. 6.5 dBi with frequency range from 700 MHz to 8 GHz.

- The scaling factor τ = 0.90 and spacing factor σ = 0.16 was chosen to obtain the dimensions using design guidelines proposed by Carrel [1].

- Transform the dimensions of LPDA to PLPDA by considering the dielectric constant of the substrate.



$$\alpha = \tan^{-1}\left[\frac{1-\tau}{4\sigma}\right]$$

$$\tau = \frac{L_{n+1}}{L_n} = \frac{d_{n+1}}{d_n} \qquad \sigma = \frac{s_n}{2L_n}$$

Design approach

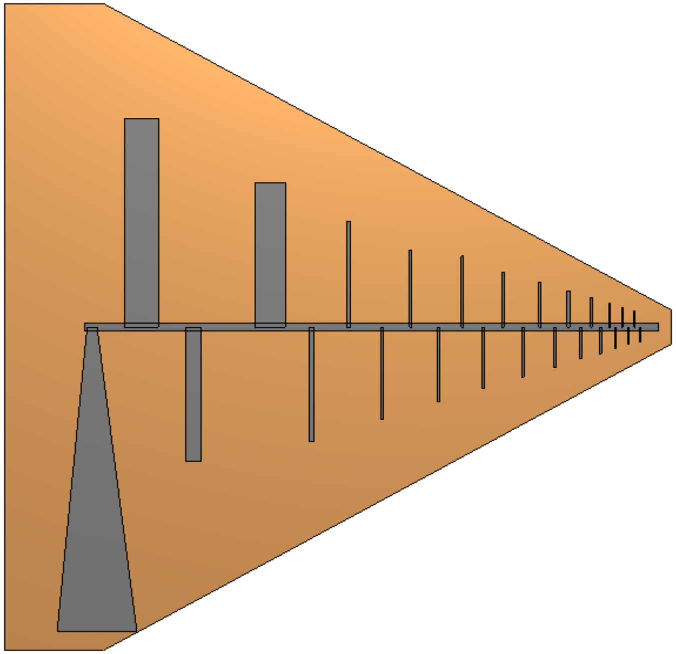
- The lengths of the dipoles, the dipole diameters and the spacings between the dipoles are modified by calculating $(l_n/\sqrt{\varepsilon_{eff}})$, $(d_n/\sqrt{\varepsilon_{eff}})$ and $(s_n/\sqrt{\varepsilon_{eff}})$ respectively.

- In order to extend the operating frequency range of the antenna at lower frequencies, the longest dipole element of the transformed PLPDA design was first replaced by a triangular dipole.

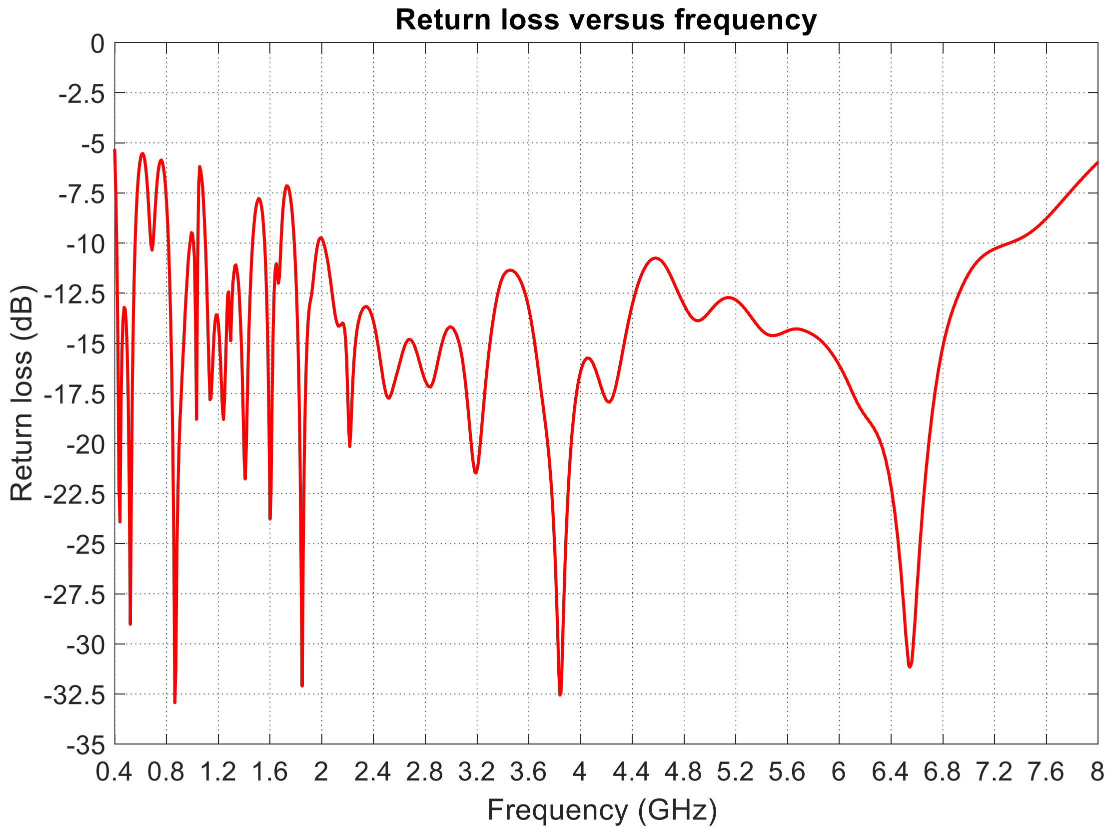
- Then, the lengths and the thickness of the last four dipoles (including the triangular dipole) were optimized to extend the bandwidth of the antenna.

Proposed antenna design

- The model was designed in CST with the dimensions calculated using the discussed design approach.
- Operating frequency range: 400 MHz to 8 GHz
- Realized gain: 6 dBi approx.
- Linear polarization
- The overall dimensions of the optimized PLPDA are: 270 mm x 279 mm x 1mm.

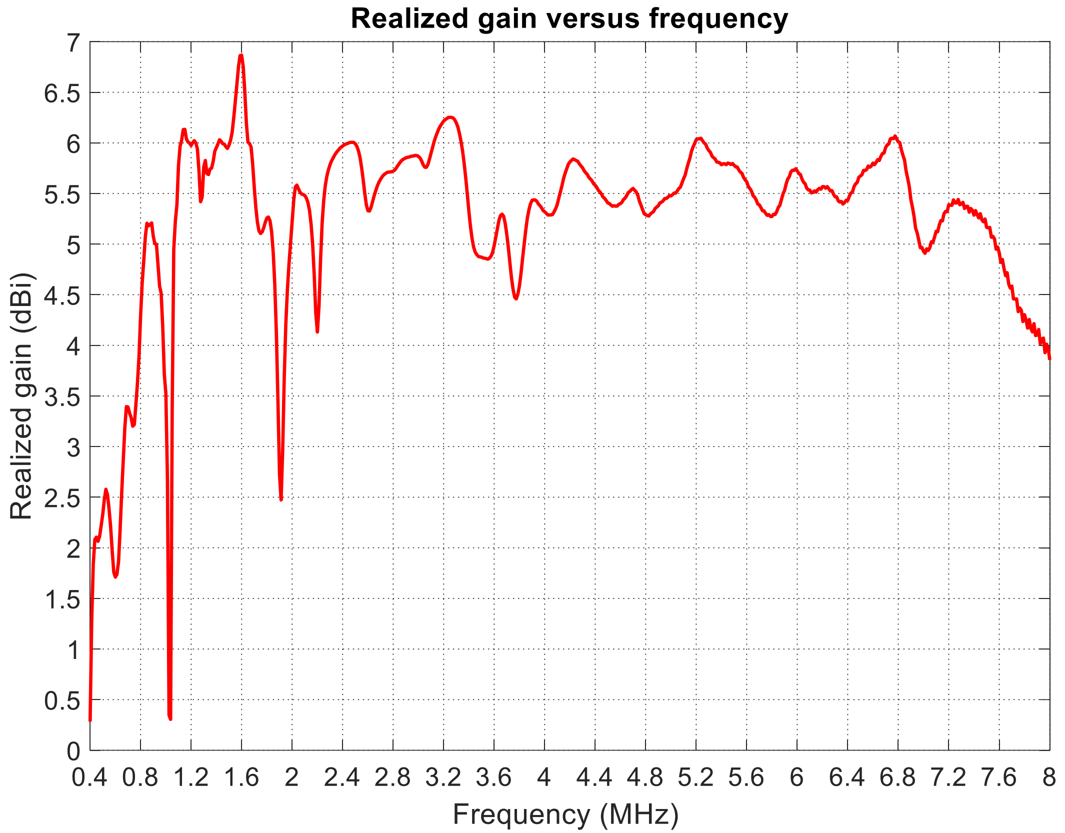


Return loss



- Return loss below -10 dB in most of the bandwidth.

Realized gain

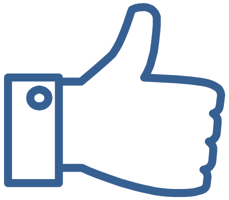


- Approx. 5.5 dBi gain achieved. Further improvement required to increase the gain.

Conclusion

- A PLPDA antenna design with triangular longest dipole is proposed in this paper, that has an operating frequency range from 0.4 GHz to 8 GHz.
- The antenna provides a realized gain of approximately 5.5 dBi and above in most of its operating bandwidth.
- The proposed antenna has a reduced overall size compared to a conventional LPDA as well as a conventional PLPDA. The antenna is 270 mm long, 279 mm wide and 1 mm thick.

THANK You!



Any questions

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