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The effect of geometry on the feed impedance for a PCB-dipole antenna and the time domain radiation emission from the feed point

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Near-surface GPR applications, such as landmine detection, have their own peculiarities:

1. By definition, the reflection from objects of interest are often close in time to reflections from the top of the soil. Compact excitation signals are needed to separate these reflections.
2. To reconstruct the position of objects in the soil, knowledge of the system's Spatio-Temporal Point Spread Function (ST-PSF) is needed.

These two requirements link to an understanding of the role of feed impedance in antenna design.

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Why compact excitation signals are needed:

1. Near-surface GPR requires a wide bandwidth to obtain high down-range resolution.
2. Wide bandwidth implies a high centre-frequency.
3. But high frequencies get absorbed preferentially by the soil.
4. Large soil attenuation requires a steep time-varying gain.
5. High gain creates ambiguities between deep objects and shallow targets, if the wavelet has a long ring-down.
6. Long duration ring-downs may mask resonances of target reflections, making their identification difficult.

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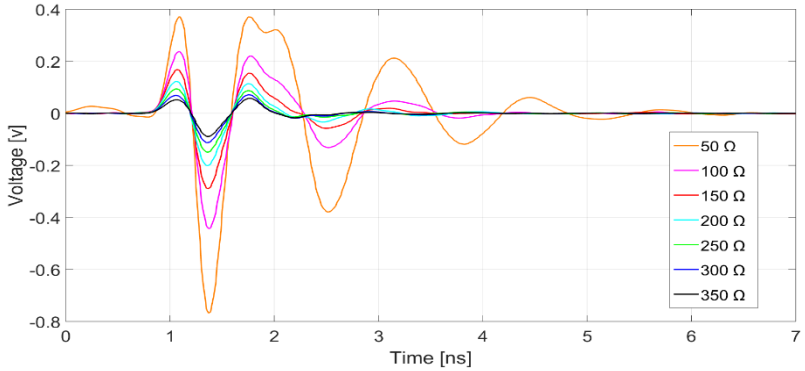
Creating Antennas with fast ring-down

1. Choosing the match between the electrical network impedance and the antenna impedance, can have a big effect on the pulse amplitude and the rate of ring down.



✗ Pulse amplitude is smaller.

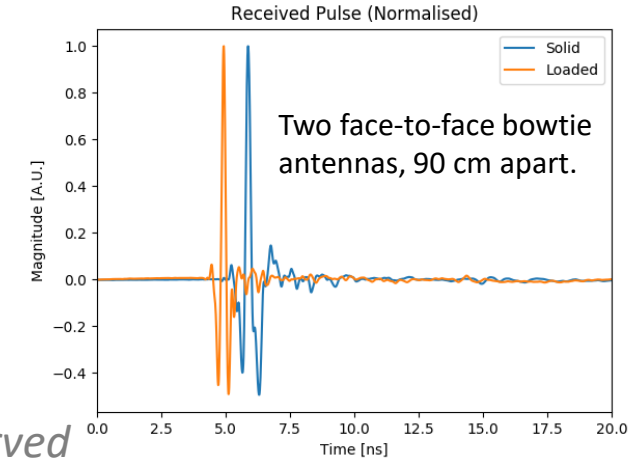
✓ The ring-down is faster.

2. Another option is to "load" the antenna, often using resistors or cutting gaps into the copper to create capacitances.

✗ Loaded antenna wavelet is narrower.

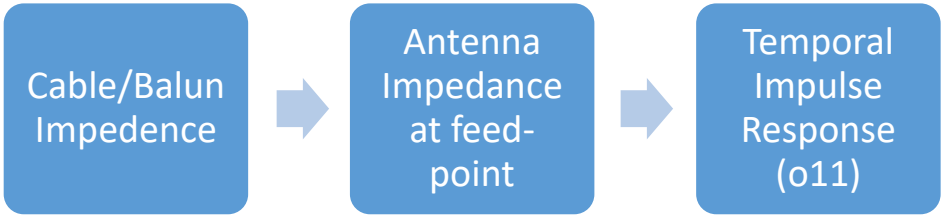
✗ Pulse amplitude is smaller.

✓ The ring-down is faster.

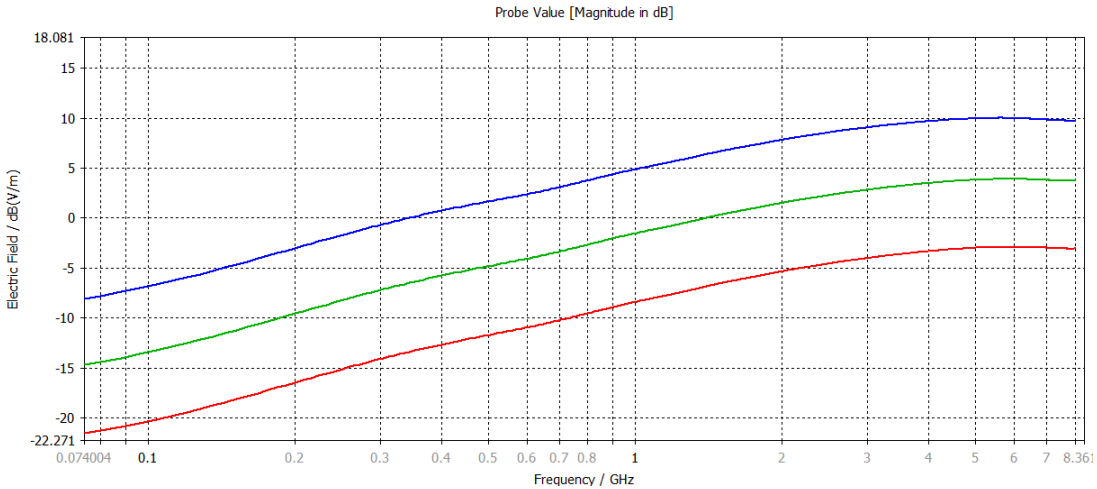


Feed/Antenna impedance in antenna pulse shape design

- Antenna impedance is complex (amplitude & phase), and frequency dependent.
- The antenna geometry affects the antenna impedance e.g.
  - flare angle & length of a bow-tie,
  - track width & copper thickness, and length of a PCB wire dipole
- The o11 signal shape can be optimised by the selection of antenna geometry and balun



- The balun impedance also changes the strength of the radiated E-field from the feed-point.



50 ohms
10 ohms
2 ohms