Super Radar

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Range resolution is the ability to determine the distance between two objects along the same line-of-sight when performing remote sensing. The prevailing thought is that radar range resolution is inextricably linked to the inverse bandwidth of a pulse or to the wavelength of the electromagnetic wave owing to the coherent nature of the interfering wavefronts. We quote, "Wave theory indicates that the best vertical resolution that can be achieved is one quarter of the dominant wavelength. Within that vertical distance any reflections will interfere in a constructive manner and result in a single, observed reflection" (originally stated in [1] and quoted in [2]). The desire for better range resolution has driven scientists and engineers to ever-higher frequencies radar and lidar.

However, this comes at a severe cost because transmission through and reflection from various material media is critically tied to frequency. We show how to improve range resolution as much as 1000× better than the inverse bandwidth with distance resolution up to 30,000,000× better.

References

[1] R E Sheriff, Limitations on Resolution of Seismic Reflections and Geologic Detail Derivable from Them, in: C E Payton, Seismic Stratigraphy – Applications to Hydrocarbon Exploration, American Association of Petroleum Geologists, vol. 26, 1977

[2] A Neal, Earth Sci. Rev. **66**, 261 (2004)