



Super Interferometric Range Resolution

Chapman Case #2023-005

Market Need

Advanced radar technology has always been an integral part of systems serving industries from medical imaging, precision manufacturing, aerospace, defense, and even archeology. Businesses operating in these sectors face a critical challenge: the inherent trade-off between wavelengths and range resolution. For medical imaging professionals, the ability to detect minute anomalies within the human body demands unparalleled resolution, a requirement often at odds with the need for signal penetration. In aerospace and defense applications, the need to identify small targets amidst cluttered environments clashes with the necessity of signal propagation over vast distances or through various materials. These markets need a transformative solution – a radar solution that navigates the complexities of wavelengths and distance resolution, offering superior precision without compromising penetration capabilities.



Chapman Solution

Dr. John Howell and Dr. Andrew Jordan of Chapman University's [Institute for Quantum Studies](#) have invented a new class of temporal radar functions that demonstrated several orders of magnitude improvements in range resolution (more than 100 times better than the long-believed limit). Traditional radar functions are limited in their range resolution due to the critical dependence of transmission and reflection on frequency. The proposed invention relies on the superposition of specially-crafted waveforms; when a radio wave reflects from two different surfaces, the reflected radio waves add to form a new radio wave. It uses purpose-designed pulses to generate a new kind of superposed pulse. The composite wave has unique sub-wavelength features that can be used to predict the distance between the objects. The tailored waveforms in this invention are self-referencing, enabling the target to be distinguished from loss of signal. By employing functions with both steep and zero-time gradients, it is possible to measure extremely small changes in the waveform to precisely predict the distance between two objects while still being robust to absorption losses.

Applications

- Medical diagnostics and research
- Non-destructive testing
- Remote sensing
- Precision manufacturing
- Archeology - the ability to distinguish between a coin deep underground from a pottery shard

Key Publication

“[Super Interferometric Range Resolution](#)”, American Physical Society – Physical Review Letters, August 2023.

Intellectual Property

- Patent application filed

Stage of Development

- Demonstrated experimentally that it is possible to obtain range resolution far better than the Rayleigh criterion or the inverse bandwidth
- Available for licensing and further research collaborations

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