

## **Single Frequency Thermal Wave Radar: a Next-Generation Dynamic Thermography for Quantitative Non-Destructive Imaging over Wide Modulation Frequency Ranges**

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Single-Frequency Thermal Wave Radar Imaging (SF-TWRI) was introduced and used to obtain quantitative thickness images of coatings on an aluminum block and on polyetherketone (PEEK), and to image blind subsurface holes in a steel block. In SF-TWR, the starting and ending frequencies of a linear frequency modulation (LFM) chirp are chosen to coincide. Using the highest available camera frame rate, SF-TWRI leads to a higher number of sampled points along the modulation waveform than conventional lock-in thermography imaging (LITI) because it is not limited by conventional undersampling at high frequencies due to camera frame-rate limitations. This property leads to large reduction in measurement time, better quality of images and higher signal-noise-ratio (SNR) across wide frequency ranges. For quantitative thin-coating imaging applications, a two-layer photothermal model with lumped parameters was used to reconstruct the layer thickness from multi-frequency SF-TWR images. SF-TWRI represents a next-generation thermography method with superior features for imaging important classes of thin layers, materials, and components that require high-frequency thermal-wave probing well above today's available infrared camera technology frame rates.