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TSR: ORIGINS AND OBSERVATIONS

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ABSTRACT

Like many developments in science, the Thermographic Signal Reconstruction (TSR) method was an unforeseen byproduct of an experiment with a very different objective than the technique that has since evolved. Initial experiments were focused on improving the signal-to-noise content IR flash image sequences acquired using analog data from uncooled cameras. In those first experiments, simple least-squares fitting of each log-log pixel time history to a polynomial provided a reasonably accurate replica, with temporal noise essentially eliminated. Surprisingly, images created from these "reconstructed" signals were disappointing, as images were "cleaner", but detectability of subsurface features was not significantly improved by temporal noise reduction. However, several observations emerged from these experiments: a) the derivatives of the reconstructed signals were an extremely effective way to enhance detectability; b) regardless of the absolute temperature behavior, the derivative behavior was predictable and could be used for quantitative analysis, and; c) the coefficients of the fitting equations could be archived and manipulated instead of the collected raw sequence data, facilitating fast computation, significant data compression, and simultaneous processing of multiple data sets. These observations have formed the basis of the TSR method as it is used today for measurement, quality control and automated defect detection, using a wide range of cameras, excitation sources and detection schemes. We will describe the evolution of the technique since its inception, and also discuss recent developments.