Methodologies for non-Gaussian modelling in signal and image processing

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Due to the stochastic nature of measured signals and images, statistical modelling has a long tradition in science and engineering. In the literature, Gaussian signal statistics is often taken as the default hypothesis. The reason for this is that this distribution has been known for centuries, it often leads to convenient closed form mathematical expressions, and in many cases the signal generation process is supported by the central limit theorem. Measurements may, however, reveal that this hypothesis is not always true. There are many examples in signal and image processing where non-Gaussian models give better representation of real data, implying that processing algorithms based on non-Gaussian statistics improve system performance. In this presentation, we discuss both theoretical aspects and practical applications of a family of relatively simple non-Gaussian models, the so-called product models, which build the signal statistics as a compound model of a Gaussian noise component and a positive, random scaling component. Using examples from the analysis of single and multiple polarization Synthetic Aperture Radar (SAR) data, we present methodologies for scalar-, vector-, and matrix random variables.