## Abstract Submitted for the DFD19 Meeting of The American Physical Society

Power Law Decay Estimation for Turbulent Spectral Densities CARL R. HART, U.S. Army Engineering Research and Development Center, Cold Regions Research and Engineering Laboratory, GREGORY W. LYONS, U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory, NATHAN E. MURRAY, The University of Mississippi, National Center for Physical Acoustics — Turbulent flows commonly feature power law decay in one or more field quantities, such as the -5/3 inertial subrange power law for velocity spectra. Assuming sufficient time series data are collected, the problem of estimating the power law decay rate of a turbulent spectral density relies on two factors: the correct choice of data window in statistical signal processing, and an objective procedure to estimate the power law decay rate. In this context the single most important factor for a data window is the side-lobe decay rate. Ensuring the side-lobe decay rate exceeds that of measured data avoids the subtle error of spectral leakage. An objective procedure to estimate the power law decay rate is based on a maximum likelihood estimator. Under the assumption that the Fourier transform of turbulence time series is a circularly-symmetric complex normal random variable a likelihood function for the power spectral density is based on a Gamma distribution. Maximizing the log-likelihood, with a spectral model that parameterizes the Gamma distributions, leads to a robust estimator for the power law decay rate. These concepts are illustrated through synthetic realizations of colored noise, acoustic measurements of a supersonic turbulent jet, and atmospheric surface-layer turbulence.

> Gregory Lyons U.S. Army Engineer Research And Development Center

Date submitted: 01 Aug 2019

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