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A Method of Enhancing the Signal-to-Noise of Transient Radio and Gravitational Wave Sources KRISTEN LACKEOS, NASA Postdoctoral Program Fellow, NASA Marshall Space Flight Center,, RICHARD LIEU, Department of Physics, University of Alabama in Huntsville — The Gaussian phase noise of radio intensity time series is demonstrated to be drastically reduced when the raw voltage data are digitally filtered through an arbitrarily large number n of orthonormal bandpass profiles sharing the same intensity bandwidth, and the resulting intensity series are co-added. Specifically, the relative noise variance of the summed series at the resolution of one coherence time or less, goes down with increasing n as $1/n$, although (consistent with the radiometer equation) the advantage gradually disappears when the series is bin averaged to lower resolution. Thus the algorithm is designed to enhance the sensitivity of detecting transients that are smoothed out by time averaging and too faint to be visible in the noisy unaveraged time series, as demonstrated by the simulation of a weak embedded time varying signal of either a periodic nature or a fast and unrepeated pulse. The algorithm is then applied to a 10 minute observation of the pulsar PSR 1937+21 by the VLA, where the theoretical predictions were verified by the data. Moreover, it is shown that microstructures within the time profile are better defined as the number n of filters used increases, and a periodic signal of period 1.86×10^{-5}s is discovered in the pulse profile.

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