Multifractal Modeling of Computer Network Traffic

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Abstract

Network traffic analysis is the study of the flow of packets across a network. Two measurements of the aggregate flow at a choke point are the interarrival process (the times between the successive arrivals of packets) and the packet rate process (the number of packets arriving per unit time). One objective of analysis is to characterize the state of network traffic by modeling the aggregate interarrival or packet rate processes.

The packet rate process is naturally thought of as a (coarse-grained) probability density or measure. Its observed high degree of burstiness across many (time) scales suggests a multifractal model. The multiplicative cascade is one method of generating a multifractal measure. The use of two explicit cascade models, the semi-random multiplicative cascade model (Gilbert, Willinger and Feldman) and the multifractal wavelet model (Riedi, Crouse, Ribeiro and Baraniuk) will be explored. The computation of both analysis and synthesis steps will be described, and the modeling results on a set of live network traffic data analyzed. A new visualization of the results of the semi-random cascade model will be presented.