Rapid Exact Signal Scanning with Deep Convolutional Neural Networks

Abstract:

A rigorous formulation of the dynamics of a signal processing scheme aimed at dense signal scanning without any loss in accuracy is introduced and analyzed. Related methods proposed in the recent past lack a satisfactory analysis of whether they actually fulfill any exactness constraints. This is improved through an exact characterization of the requirements for a sound sliding window approach. The tools developed in this paper are especially beneficial if Convolutional Neural Networks are employed, but can also be used as a more general framework to validate related approaches to signal scanning. The proposed theory helps to eliminate redundant computations and renders special case treatment unnecessary, resulting in a dramatic boost in efficiency particularly on massively parallel processors. This is demonstrated both theoretically in a computational complexity analysis and empirically on modern parallel processors.