A multidimensional, event-by-event, statistical weighting procedure for signal to background separation

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Many current analyses in nuclear and particle physics are in search for signals that are encompassed by irreducible background events. These background events, entirely surrounding a signal of interest, would lead to inaccurate results when extracting physical observables from the data, due to the inability to reduce the signal to background ratio using any type of selection criteria. By looking at a data set in multiple dimensions, the phase space of a desired reaction can be characterized by a set of coordinates, where a subset of these coordinates (known as reference coordinates) contains a distribution where the signal and background can easily be determined. The approach then uses the space defined by the non-reference coordinates, to determine the k-nearest neighbors of an event, where these events can then be fit on the reference coordinates of these k-nearest neighbors (using an unbinned maximum liklihood fit, etc.). From the fit, a quality factor can be defined for each event in the data set that states the probability that it originates from the actual signal of interest. The unique aspect of this procedure requires no *a priori* information of the signal or background distributions within the phase space in the desired reaction. This and many other useful properties for this statistical weighting procedure is what makes this method more advantageous in certain analyses than other methods. A detailed overview of this procedure will be shown along with examples using Monte Carlo and GlueX data.