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Preliminary Diagnostic Testing of LDA Data-Sets

by
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ABSTRACT

Determination of the quality of an LDA data-set is important for both the experimenter to decide on repetition of the experiment and the scientific community to know that the results are valid within certain limitations. Objective quality determination is also of importance for optimisation of LDA systems and for the novice user to get feedback on the quality of his/her experimental data.

The time interval distribution shows to be very useful for this purpose. A number of distinct deviations from the ideal exponential distribution occur which are indicative for incorrect settings of the burst validation criteria, dead time of the processor, velocity or particle rate bias, round-off errors of the clock and/or the data-file, arrival time noise and multiple validation. These aspects are of importance for different error sources in LDA. Multiple validation, which means that more than one velocity estimator is derived from a single Doppler signal, showed to be detrimental to the results and should therefore be avoided (Van Maanen (1999)). The time interval distribution is very effective for this purpose.

The raw velocity data (as a function of time) should behave in agreement with the flow under study. E.g. large excursions, which occur during a short period of time, are suspect. Especially in combination with the higher moments of the velocity probability distribution and the logarithmic velocity probability distribution, incorrect behaviour of the system can be revealed.

The auto correlation function, estimated using the slotting technique with local normalisation (Van Maanen (1999)), shows to be sensitive to multiple validation. The number of products in each slot is sensitive to velocity bias as well as round-off errors. Both properties are very useful for the determination of the quality of data-sets.

Although the diagnostic tools do not provide the final answer on the quality of the data-sets, they are very helpful in this respect. They can be used for intercomparison, but also for the training of novel users. As LDA still is a complicated technique, this is an important application. We have found it a very effective technique to teach novices in the field. One could also think that the results of the diagnostic testing should be made available for peer reviewers, so that they can be convinced of the quality of the underlying data, on which the conclusions are based.