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Pull-validation: A resampling method to improve the usage of low-statistics datasets

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In high energy physics many background dominated analyses suffer from limited statistics in simulation: With increasing efficiency of the event selection the simulated samples are reduced so that in many cases the event number at final analysis level is very low. Due to limited computational resources the production of more simulation is not always feasible. In this cases it is helpful to extract more information from the available simulated data sets. One way to deal with this issue in multivariate analyses (MVA) can be achieved by using resampling methods: The MVA is trained many times on small subsets that are randomly resampled from the complete dataset. The variation of the MVA output between the trainings can be interpreted as probability density function (PDF) for each event. This PDF can be used to calculate a weight that is applied to each event instead of making a binary cut decision. With this procedure events that were normaly removed by the event selection can still contribute to the final dataset with a small weight. Another advantage is that pull-validation also provides an estimator for the uncertainty of the multivariate method. As an example of how the method can be used, we present a case-scenario from searches for physics beyond the Standard Model with IceCube.

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351

Authors: OBERTACKE, Anna (Universität Wuppertal);   SCHERIAU, Florian (Technische Universität Dortmund);   KUNNEN, Jan (Vrije Universiteit Brussel);   LUENEMANN, Jan (Vrije Universiteit Brussel)

Presenter: LUENEMANN, Jan (Vrije Universiteit Brussel)

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