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Alignment of the LHCb detector with Kalman fitted tracks

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We report on an implementation of a global chisquare algorithm for the simultaneous alignment of all tracking systems in the LHCb detector. Our algorithm uses hit residuals from the standard LHCb track fit which is based on a Kalman filter. The algorithm is implemented in the LHCb reconstruction framework and exploits the fact that all sensitive detector elements have the same geometry interface. A vertex constraint is implemented by fitting tracks to a common point and propagating the change in track parameters to the hit residuals. To remove unconstrained or poorly constrained degrees of freedom (so-called weak modes) the average movements of (subsets of) alignable detector elements can be fixed with Lagrange constraints. Alternatively, weak modes can be removed with a cutoff in the eigenvalue spectrum of the second derivative of the chisquare. As for all LHCb reconstruction and analysis software the configuration of the algorithm is done in python and gives detailed control over the selection of alignable degrees of freedom and constraints. The study the performance of the algorithm on simulated events and first LHCb data.

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