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A Kalman Filter for Track-based Alignment

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The Inner Tracker of the CMS experiment consists of approximately 20,000 sensitive modules in order to cope with the bunch crossing rate and the high particle multiplicity expected in the environment of the Large Hadron Collider. For such a big number of modules conventional methods for track-based alignment face serious difficulties because of the large number of alignment parameters and the huge matrices that are involved in the estimation process. For this reason we propose an iterative (track-by-track) method for track-based global alignment. It is derived from the Kalman filter and does not require inversions of large matrices. The update formulas for the alignment parameters and for the associated covariance matrix are presented. We discuss the implementation and the computational complexity and show how to limit the latter to an acceptable level. The performance of the method with respect to precision and speed of convergence is studied in a simplified setup. Scenarios closer to the CMS experimental setup are studied using a first implementation within the CMS reconstruction framework ORCA. Results for the barrel part of the CMS Inner Tracker under these more realistic circumstances are presented.

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