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Recent Developments in Pattern Recognition with Applications in High Energy Physics

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In this contribution we consider the track finding and fitting problem from the pattern recognition and computer vision point of view. In particular, we consider it as a problem of recovering parametric models from noisy measurements. We review major approaches like neural networks, hough transforms, Kalman filtering techniques, etc, which have been previously used in that area, and point out the problems of these approaches. Then we present an algorithm, originally developed in the area of computer vision, to fit different types of curves to noisy edge data, and demonstrate how it can be used for track finding and fitting. The algorithm is based on two principles: a) A data driven exploration produces many hypotheses of possible tracks. b) A selection procedure based on the Minimum Description Length Principle (MDL), selects those hypotheses which are needed to explain the data. The results of the algorithm are a number of tracks, and a set of outlier points (which can not be explained by tracks according to the MDL-principle). We discuss how knowledge about the detectors and the underlying processes can be incorporated in the algorithm. Finally, we demonstrate that this algorithm has various advantages over other methods, is robust, and produces highly accurate results.