
Dual Approaches for Elliptic Hough Transform: Eccentricity/Orientation vs Center based

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Abstract

Ellipse matching is the process of extracting (detecting and fitting) elliptic shapes from digital images. This process typically requires the determination of 5 parameters, which can be obtained by using an Elliptic Hough Transform (EHT) algorithm. In this paper, we focus on Elliptic Hough Transform (EHT) algorithms based on two edge points and their associated image gradients. For this set-up, it is common to first reduce the dimension of the 5D EHT by means of some geometrical observations, and then apply a simpler HT. We present an alternative approach, with its corresponding algebraic framework, based on the pencil of bi-tangent conics, expressed in two dual forms: the point or the tangential forms. We show that, for both forms, the locus of the ellipse parameters is a line in a 5D space. With our framework, we can split the EHT into two steps. The first step accumulates 2D lines, which are computed from planar projections of the parameter locus (5D line). The second part back-projects the peak of the 2D accumulator into the 5D space, to obtain the three remaining parameters that we then accumulate in a 3D histogram, possibly represented as three separated 1D histograms. For the point equation, the first step extracts parameters related to the ellipse orientation and eccentricity, while the remaining parameters are related to the center and a sizing parameter of the ellipse. For the tangential equation, the first step is the known center extraction algorithm, while the remaining parameters are related to the ellipse half-axes and orientation.

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