

Hough Transform of Special Classes of Curves

M. C. Beltrametti¹, A. M. Massone², and M. Piana^{1,2}

¹ Dipartimento di Matematica, Università degli Studi di Genova, Genova (Italy)

² CNR-SPIN, Genova (Italy)

SIAM Journal on Imaging Sciences 6 (1), 391-412 (2013)

The Hough transform is a standard pattern recognition technique introduced between the 1960s and the 1970s for the detection of straight lines, circles, and ellipses in images. In the present paper we show that the Hough transform can be effectively applied for the automatic recognition of specific classes of curves whose algebraic forms are known but are significantly more complicated than straight lines or conics. For a large variety of these algebraic curves, we have proved a duality-type correspondence between the image and the parameter spaces by showing that each curve in the image space is transformed into a curve in the parameter space in such a way that all curves meet in one and only one point. This point uniquely identifies the original curve to be detected. Then we have implemented a numerical algorithm that realizes the recognition in a robust and automatic way.

We believe that this pattern recognition procedure may have applications in several domains of applied science, like in the processing of high resolution images from astronomical satellites (Fig. 1) and in medical imaging. Indeed, a specific work in progress involving this technique is concerned with the automatic description of the human skeleton districts for applications in oncology and neurology (Fig. 2).

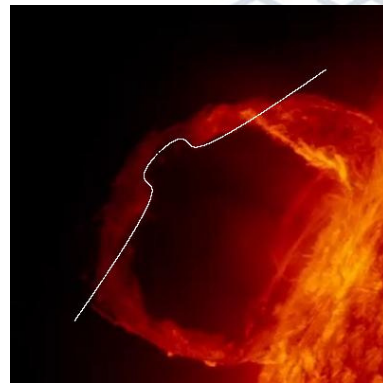


Fig. 1:
Detection of an elliptic curve in an Extreme Ultra-Violet (EUV) image recorded by the NASA SDO/AIA telescope in the 304 Å channel.

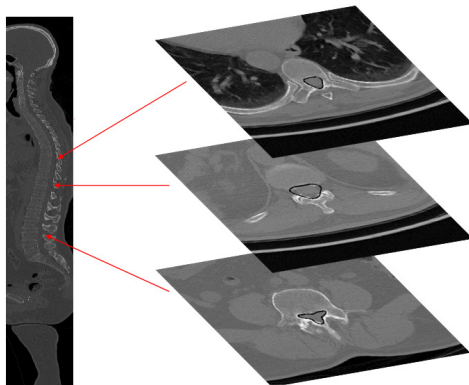


Fig. 2:
A possible application of the pattern recognition method illustrated in the paper: detection of the spinal canal in clinical X-ray tomography images.