Arc and Line segment Detection (ALD) – white paper

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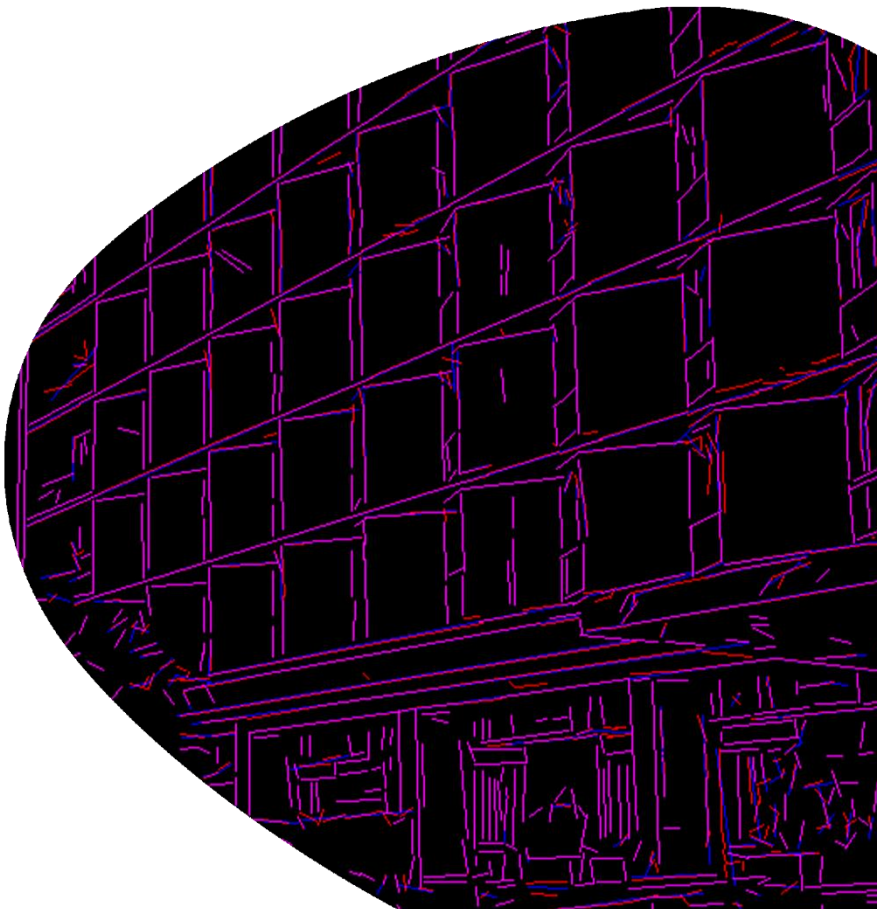
saiwa

simple artificial intelligence web application

Arc (elliptical and circular arcs) **and Line Segment Detection** is an important problem in image processing and computer vision. It has many applications, including: automatic inspection of manufactured products, sporting event analysis, pupil and iris detection, camera calibration using geometric patterns, circular traffic sign detection, and many others [1]. There are many geometric primitive detectors that extract one single primitive type, e.g., line segments, ellipses, or circles. They primarily use different versions of the Hough Transform, or edge chaining methods. The first category of methods usually start with computing an edge map of the image using an edge detector like Canny. Then, the edge points are mapped into the Hough space and finally the corresponding primitive is extracted which contains a certain number of edge points.

ARC & LINE SEGMENT

In the second approach, where detection methods rely on edge chaining, the geometric properties of the corresponding primitives, such as straightness criteria for line segments or curvature properties for ellipses and circles, are used instead.



In saiwa's **Arc and Line segment Detection (ALD)** service, we employ a recent method that jointly extracts elliptical arcs, circular arcs and line segments based on *a contrario* theory [3] which is called ELSDc [2]. ELSDc detection goes through three main steps: 1) candidate generation; 2) candidate validation; and 3) model selection. Using a statistical criterion based on the *a contrario* theory for a given region of pixels (candidate generation) in an input image, ELSDc chooses between a line segment, an elliptical arc or a circular arc (candidate validation). If more than one interpretation is possible for the same region, the detector chooses that which is most meaningful (model selection). Later, the ELSDc algorithm was extended in another work wherein a whole candidate is interpreted by an arcline, namely a sequence of line segments, circular arcs and elliptical arcs [4].

Figure 1 shows the results of applying ELSDc algorithm on several natural images using saiwa ALD service interface. In ALD service an open-source implementation of ELSDc algorithm which has been distributed by the original paper authors is used [5].

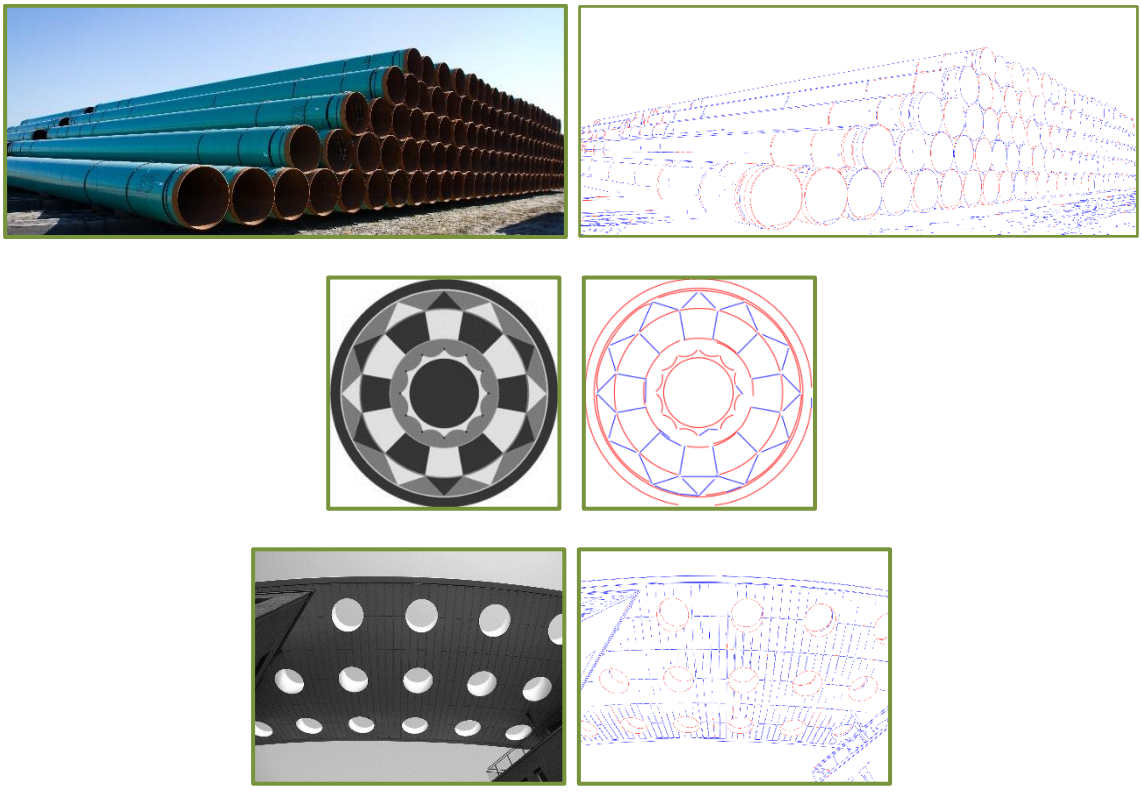


Figure 1. ALD results on natural images using saiwa Arc and Line segment Detection service interface.

References:

[1] Akinlar, Cuneyt, and Cihan Topal. "EDCircles: A real-time circle detector with a false detection control." Pattern Recognition 46.3 (2013): 725-740.

[2] Pătrăucean, Viorica, Pierre Gurdjos, and Rafael Grompone von Gioi. "Joint a contrario ellipse and line detection." IEEE transactions on pattern analysis and machine intelligence 39.4 (2016): 788-802.

[3] Desolneux, Agnes, Lionel Moisan, and Jean-Michel Morel. From gestalt theory to image analysis: a probabilistic approach. Vol. 34. Springer Science & Business Media, 2007.

[4] Rajaei, Boshra, and Rafael Grompone von Gioi. "A Contrario Elliptical Arc, Circular Arc and Line Segment Detection." VISIGRAPP (4: VISAPP). 2020.

[5] https://github.com/viorik/ELSDc.

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