Fast Stamping Side Detection

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Summary

This paper considers the task of automatic stamping side detection and presents a method that uses the statistics of features extracted from oblique lighted edges to compute a discriminating intensity ratio that performs stamping side detection in a very robust way.

Introduction

Given the nature of the stamping process, stamped parts exhibit different edges on both sides. Round edges characterize the introduction side while the side with sharp edges is known as the burr side. As many stamping post processing operations apply differently on both sides of the parts, we consider here the task of automatic stamping side detection for the purpose of side sorting prior to specific subsequent processing steps like burr removal.

Available methods relying on shape asymmetry [1] cannot be used because they do not apply to symmetric shapes. Methods based on 3D structure measurement are quite complex and therefore not well suited [2]. The innovative method presented in this contribution relies on oblique lighting and evaluation of edge feature statistics along the stamping contours.

Side detection method

The innovative method relies on oblique lighting and evaluation of edge feature statistics along the stamping contours (fig. 1). More specifically, directional oblique lighting generates edge reflections that differ significantly as a function of the edge orientation. The strongest discrimination between contours from round and sharp edges appears in the two positions when the contour is perpendicular to the incident light: the two positions are characterized by contours facing the light source on one hand and contours facing the opposite direction on the other one.

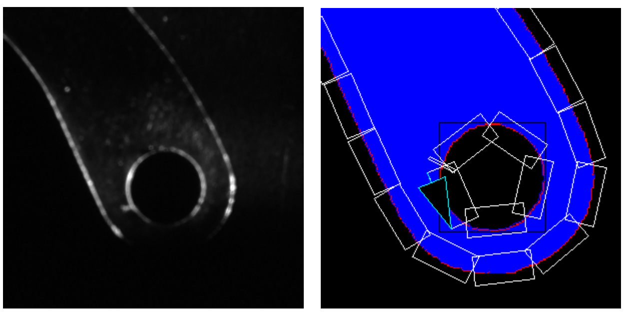
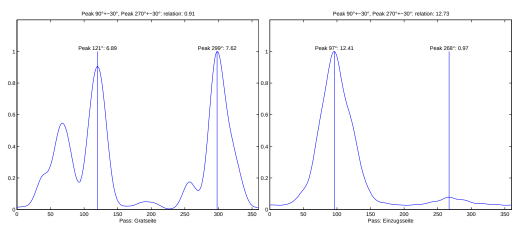


Fig. 1 From oblique lighted contour to segments



a) burr side b) round side

Fig.2 Typical I(φ) distributions

If we denote by I_1 and I_2 the contour intensities for the facing respectively opposite contour intensities, then the ratio $R=I_2/I_1$ is a good discriminator for side detection. It is close to 1 for sharp edges and tends to zero for round edges.

Using this basic principle, the method was developed for optimal robustness and comprises 3 distinct steps. First the contour line is divided into K segments of same length, each characterized by intensity I(k) and orientation φ(k) with respect to the incident oblique light. The average intensity distribution I(φ) as a function of the edge orientation is then computed. The final intensities $I_1$and I_2 required for computing the discriminating ratio R are finally obtained by performing a local averaging of the function I(φ) in the vicinity of φ_1 = 90° and φ_2 = 270° respectively, by means of a bell shaped weighting function.

As an example, figure 2 shows typical distributions of the I(φ) function. The locations of interest are the values around φ_1 = 90° and φ_2 = 270°. The distribution is clearly bimodal in presence of the burr side, while in presence of the round edges, the distribution is monomodal. From this figure, the interest of the ratio R given above appears therefore quite obviously.

The presented visual inspection procedure was practically implemented. It automatically detects the burr side of stampings as they are moved by a transport belt under a viewing configuration. The developed procedure is robust and detects even hardly noticeable burrs. A typical configuration can handle up to 150 mm wide parts at a rate better than 10 parts per second. A specific implementation admits parts moving at a speed of 50 cm/s. Under this configuration the system detects burrs with sizes down to 40 μm. Being fast, the method remains quite simple.

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Conclusion
Based on oblique lightning and dedicated robust feature extraction and classification methods, the stamping side detection procedure produces a bimodal feature profile for burr side views while a typical monomodal profile is obtained in presence of the round edge views. The profile clearly distinguishes the two sides. A ratio R for simple decision was proposed.

The procedure is very versatile as it accepts arbitrary shaped and arbitrary oriented objects. Also symmetrical objects are accepted and there is further no need to provide a part description to the procedure. Fast part detection is possible. Also, because the method is global, there is no need for very high resolution, relaxing camera constraints and costs. This versatile burr side detection procedure opens new perspectives for automatically sorting and flipping stampings ahead of the post processing stage.

References
[1] B.G. Batchelor & P. Whelan, "Intelligent Vision Systems for Industry", Ed. by authors, University of Wales and Dublin City University, pp.303-305

[2] Liang, S.Y., Hecker, R.L., and Landers, R.G., 2004, "Machining Process Monitoring and Control: The State–of–the–Art," *ASME Journal of Manufacturing Science and Engineering*, Vol. 126, No. 2, pp. 297–310