Tensor Flow for Five-axis Machining

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Abstract. Five-axis toolpath (TP) based on a set of preferred directions is a trademark of the modern five-axis machining. The TP generation requires a multidisciplinary approach. It combines the multi-axis robotics, optimization, complex analysis and elements of image processing such as clustering, vector and tensor field analysis. Many research papers treat the preferred directions as a vector field (VF). Since these vectors can be flipped, this mathematical object is nothing else than the tensor field (TF) of the second order. This paper exploits this idea and presents the enhanced tensor flow (EVF) obtained by applying the parabolic model to the original VF. Clustering of the TF makes it possible to improve the surface quality and the machining time. The model has been tested against selected standard methods the real and virtual machining of stereolithography (STL) surfaces. The proposed transdisciplinary approach shows the advantage of about 20% in terms of the machining time.

Keywords: five-axis toolpath, tensor field, effective material removal rate, standard industrial formats

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