

عنوان مقاله:

Statistical Modeling, Optimization and Sensitivity Analysis of Tool's Geometrical Parameters on Process Force in Automatic Cortical Bone Drilling Process

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نویسندگان:

M. Safari - *Department of Mechanical Engineering, Arak University of Technology, Arak, Iran*

V. Tahmasbi - *Department of Mechanical Engineering, Arak University of Technology, Arak, Iran*

P. Hassanpour - *Department of Mechanical Engineering, Arak University of Technology, Arak, Iran*

خلاصه مقاله:

One of the most prevalent machining processes in medical treatments is bone drilling process. During bone drilling, excessive process force can cause breakage, crack initiation and severe damage to bone tissue. In this paper, a systematic study with simultaneous use of response surface method, sensitivity analysis based on Sobol method and regression analysis is performed for investigation the effect of helix angle and point angle of the tool as the most important geometrical parameters on imposed force to the bone during drilling process. Initially, using design of experiments and response surface method, imposed force to the bone is modeled and the governing second order linear regression equation is derived and verified. Then, using Sobol sensitivity analysis, with ability to quantify the sensitivity, it is attempted to investigate the effect of input parameters on drilling force. Finally, optimization of the process inputs is followed to find the best combination which yields the desired drilling force. The minimum drilling force, within the range of input parameters, coincides with point angle of 90° and helix angle of 18° . This minimal force is lower than the force in surgery and standard tools. The results showed that an increasing in point angle leads to an increase in drilling force. Also, it is concluded that there is an optimum value for using the helix angle in bone drilling process with minimum imposed force.

کلمات کلیدی:

Bone Drilling Process, Crack, Statistical Sensitivity Analysis, Drilling Force

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