Towards a classification of surgical skills using affine velocity

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Abstract-

The aim of this study is to determine if navigation movements, used in surgical training, follow a particular power law which describes the relationship between the hand trajectory's curvature, torsion, and speed. Based on this approach, this study proposes the affine velocity as an appropriate classification feature to solve the surgical movement recognition problem. Eight subjects with different surgical experience were involved in the experiments. They were asked to do two kinds of movements that involve depth perception skills with their right arm. Using six video cameras and an instrumented laparoscope, the 3D trajectory of the end effector was recorded for each participant. A power law was used to fit the data sets and the exponents that relate the torsion, curvature, and speed were calculated. The exponents involved and the affine velocity for each trajectory were then computed, using a multi-variable linear regression, and compared between participants. It is shown that fitting residual follows a normal distribution indicating no regression biases. Finally, it is presented that an affine velocity analysis could be able to classify between both trajectories showing a correlation with the surgical skills and a clear difference for people with some surgical training.

Index Terms-

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