A study on the usefulness of Support Vector Machines for the realtime computational simulation of soft biological organs

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Realistic and realtime computational simulation of soft biological organs (e.g., liver, kidney) is necessary when one tries to build a quality surgical simulator that can simulate surgical procedures involving these organs. Since the realistic simulation of these soft biological organs should account for both nonlinear material behavior and large deformation, achieving realistic simulations in realtime using continuum mechanics based numerical techniques necessitates the use of a supercomputer or a high end computer cluster which are costly. Hence there is a need to employ soft computing techniques like Support Vector Machines (SVMs) which can do function approximation, and hence could achieve physically realistic simulations in realtime by making use of just a desktop computer.

Present work tries to simulate a pig liver in realtime. Liver is assumed to be homogeneous, isotropic, and hyperelastic. Hyperelastic material constants are taken from the literature. An SVM is employed to achieve realistic simulations in realtime, using just a desktop computer. The code for the SVM is obtained from [1]. The SVM is trained using the dataset generated by performing hyperelastic analyses on the liver geometry, using the commercial finite element software package ANSYS. The methodology followed in the present work closely follows the one followed in [2] except that [2] uses Artificial Neural Networks (ANNs) while the present work uses SVMs to achieve realistic simulations in realtime.

Results indicate the speed and accuracy that is obtained by employing the SVM for the targeted realistic and realtime simulation of the liver.

References