**A Novel Nonlinear Parameter Estimation Method of Soft Tissues**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5828669/>

-- Local changes in the mechanical properties of soft tissues may indicate the presence of tumor or other diseases [[1]](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5828669/#b0005), which could be detected by physicians using palpation

-- Aims to learn the elastic property of the tissue rather than just the force

-- To validate the accuracy of the WCFM\_SVM force correction model, 76 sets of samples, including forces acquired using our pressure acquisition device and their actual forces acquired using an electronic scale, were collected and divided into a training set (70 sets of samples) and a test set (6 sets of samples)

-- Uses the deformation matrix

-- Young’s modulus and Poisson’s ratio are two important parameters describing the physical properties of materials

**A grip force model for the da Vinci end-effector to predict a compensation force**

[**https://link-springer-com.libproxy2.usc.edu/content/pdf/10.1007/s11517-014-1230-2.pdf**](https://link-springer-com.libproxy2.usc.edu/content/pdf/10.1007/s11517-014-1230-2.pdf)

**--** Input different angles of indentation and output was force

-- No ML model used instead solved equations.

**Surface deformation and reaction force estimation of liver tissue**

**based on a novel nonlinear mass–spring–damper viscoelastic**

**Model**

[**https://link-springer-com.libproxy2.usc.edu/content/pdf/10.1007/s11517-015-1434-0.pdf**](https://link-springer-com.libproxy2.usc.edu/content/pdf/10.1007/s11517-015-1434-0.pdf)

-- Estimate the force using linear and nonlinear models.

-- stiffness and damping values as inputs and force as output.

-- Kelvin–Voigt, the Maxwell and the Kelvin models - for calculating stiffness and damping values

**Force Estimation from OCT Volumes using 3D CNNs**

[**https://arxiv.org/pdf/1804.10002.pdf**](https://arxiv.org/pdf/1804.10002.pdf)

-- Estimates force vector using Image data, CNN Model

**Estimation of Tool-Tissue Forces in Robot-Assisted Minimally Invasive Surgery Using Neural Networks**

[**https://www.frontiersin.org/articles/10.3389/frobt.2019.00056/full**](https://www.frontiersin.org/articles/10.3389/frobt.2019.00056/full)

-- Very close to what we do

-- The proposed method utilizes the current of the motors of the surgical instrument and neural network methods to estimate the force interaction

-- Error 0.20 ± 0.44 N and 0.28 ± 0.46 N