AbstractID: 11186 Title: Using total-variation regularization for deformable registration of the Shear Movement of the Lungs

Purpose: To report a deformable image registration strategy using total-variation regularization with explicit inclusion of the differential motions of thoracic structures. **Methods and Materials:** Accurate modeling of thoracic organ motions remains illusive because of the lack of an effective mechanism to deal with the discontinuous movements of the involved anatomic structures. In this work, we propose an efficient deformable registration algorithm to deal with the lung motion. Instead of directly applying the least square optimization, we include a total-variation regularization to account for the motion discontinuity close to the contact surface between lungs and chest wall. The term of total variation calculates the sum of absolute values of the derivatives, and the penalties drive the derivatives toward zeros and force the optimized displacement vector close to be piece-wise continuity. **Results:** The proposed approach is evaluated using a digital phantom case and two lung cancer patients. For the phantom case, a comparison with the Levenberg-Marquardt least square optimization showed that the registration accuracy was markedly improved. On average, the registration error of 15 representative points in the lung (against the known ground truth) was reduced from 6.0±4.1 mm to 1.6±0.7 mm when the new method was used. Similar level of improvement was achieved for the clinical cases. **Conclusions:** The deformable approach using total-variation provides a natural and logical solution to model the discontinuous organ motions and greatly improves the accuracy and robustness of deformable registration.