AbstractID: 3647 Title: Fast multimodal image registration using mutual information and variable step-size grid search algorithm

Purpose:
A robust optimization algorithm, referred to as variable step-size grid search (VSGS), is presented for 2D/2D multimodal image registration, and evaluated using phantom and clinical imaging.

Method and Materials:
The VSGS optimization algorithm is based on recursive iterations of a geometrically scaled step-size, and is more likely to converge to the global optimum and be less insensitive to the local optima compared to traditional gradient techniques (i.e. Powell, quasi-Newton). As an optimization technique, it can be used with any objective function. Here mutual information was used as the similarity measure, and a multiresolution strategy was adopted to accelerate computation without adversely affecting robustness. VSGS was applied to the problem of automatic patient positioning in radiotherapy. The multimodal imaging consists of digitally reconstructed radiographs (DRRs), portal images acquired with electronic portal imaging devices (EPID), and the Varian linac-based on-board kilovoltage imager. EPID images were collected using the Siemens BEAMVIEW video EPID and the Varian AS500 flat-panel imager.

Results:
Validation was carried out using phantom and clinical imaging data. Measurements indicated that VSGS has an accuracy of 0.5 mm (or 1 pixel) and <0.5°, and required about 8 seconds per registration on a 2 GHz PC. VSGS has an accuracy equivalent to or better than the traditional optimization techniques depending on histogram or Parzen-windowing based mutual information calculations, but is more robust and faster computationally. This allows VSGS to be used for online real-time image guided patient positioning without requiring frequent user intervention to recognize shifts associated with registrations trapped in local extrema.

Conclusion:
VSGS can be used for online real-time image guided patient positioning to achieve more accurate patient positioning than using visual verification, and is sufficiently robust compared to traditional optimization techniques to make algorithm-based registrations sufficiently robust for routine clinical use.

Conflict of Interest (only if applicable):
N/A