

Purpose: To increase image registration accuracy, and to remove the time-consuming manual region-of-interest (ROI) selection process for patient monitoring 3D surface imaging systems (AlignRT, VisionRT, UK), a method was developed to adaptively define an optimal ROI based on discovering topographically stable surfaces over time.

Methods: Our method calculates the displacement and velocity of 3D surface points between a series of images captured in real-time and the reference image. Using a set of selection criteria, the algorithm adaptively constructs a ROI by including only facial surfaces that move rigidly with the target and excludes surfaces that fluctuate locally such as the mandible regions and eyes. Data for five volunteers were acquired over various facial surface and motion types. A total of 27 data sets were analyzed, with 2–7 data sets for each volunteer and each data set contained consecutively captured 40–120 real-time images.

Results: The adaptive ROI selection algorithm correspondingly detected surfaces affected by different types of facial movement independent of target motions. It interpreted the eyes, eyebrows and mandible motions shown in the real-time 3D images as independent of target motion even when AlignRT misinterpreted them, and excluded them from the final ROI. For 3D images taken with substantial facial motions, either most of the facial areas were excluded or only small areas with random patterns were included in the final ROI. The algorithm excluded the upper side and nose where the view of the cameras was blocked, and thus surface was not well-reconstructed in many of real-time 3D images when couch was rotated greater than 40°.

Conclusion: The method successfully located suitable ROI surfaces undergoing minimal displacement and temporal fluctuation. By automating the ROI selection process, the time and complexity of current ROI definition can be reduced, together with user-dependent registration errors.