AbstractID: 9053 Title: Tumor Shape Analysis Using Poisson’s Equation

Purpose: The role that tumor shape plays in disease treatment, progression, and outcome is not well understood. This work investigates the quantification of shape information required for the statistical analysis of tumors. **Method and Materials:** The statistical shape characterization method proposed by Haidar et al. 2006 that utilizes Poisson’s equation is adapted for tumor shape parameterization. An extensive algorithm using finite differences and software toolset has been developed for efficient computation of the solution to Poisson’s equation for three-dimensional tumor volumes as well as general anatomic features. A characteristic plot that is unique to a given shape is generated. The statistical framework of this method utilizes a permutation test to establish significance between sets of characteristic plots. The method has been thoroughly tested for 2D and 3D test datasets that include simple geometric shapes as well as contoured volumes from images of the human brain. **Results:** This method is able to distinguish subtle differences in simple 2D and 3D phantoms as well as human brain anatomy. Such differences are difficult to quantify and often do not correlate to volume. Scale and translation insensitivity of the method are also proved. Imaging studies show that tumor geometries that are closely related have notably similar shape characteristics that correlate to p-values less <0.5. **Conclusion:** Tumor shape can be statistically modeled by a metric based on a 3D solution to Poisson’s equation to allow full analysis of morphology. This method yields a model by which tumors can be studied independent of translation or scale. Future work through a clinical trial aims to predict outcome based on shape-related cues that are volume independent. Research supported in part by Varian Medical Systems.