# AbstractID: 13541 Title: A novel stochastic optimization approach for multimodal image registration

**Purpose: The task of image registration appears in many different areas of radiation therapy, e.g. comparing images during the treatment planning process. However, the complexity of the existing registration algorithms requires extensive computation time which limits their applications. Therefore, we propose a fast and robust algorithm for mono and multimodal registration.**

**Method and Materials: We use the Lie Group structure to describe the set of rigid transformations and we generate the set of admissible deformations with a cubic B-spline basis in the case of non-rigid deformations. In order to solve the optimization problem that arises from the registration task, we developed a stochastic Gauss-Newton method combining the advantages of the (stochastic gradient) Robbins-Monro algorithms with the well-known deterministic Gauss-Newton method. To incorporate multimodal image registration as well, we also present a novel image distance measure. For test purposes we implemented our algorithms in Matlab.**

**Results: A comparison of the new measure with the classical mutual information measure in the case of rigid registration showed that both measures detect the position of a template image in a reference image with the same quality, but the numerical costs for one optimization step are reduced significant with the new measure. The stochastic algorithm led to a considerable reduction of computation time, compared to the deterministic Gauss-Newton method. The final algorithm was tested for CT-MR and CT-PET and CT-CT registration. Especially the last case allows to detect huge deformations which appear e.g. in patient-to-patient registration.**

**Conclusion: We have developed a novel, fast and robust registration algorithm. It combines the advantages of the mutual information measure with the superior convergence properties of a quasi adaptive stochastic algorithm.**