AbstractID: 6586 Title: Self-learning AI Technique for Parameter Optimization of IMRT Treatment Planning

Purpose: The conventional application of Fuzzy Inference System (FIS) on parameter optimization of IMRT treatment planning requires that the FIS model (membership function, inference rules) to be predetermined in an intuitive way based on prior planner's knowledge. This study is aimed to develop an automated update scheme using an Adaptive Neuro-Fuzzy Inference System (ANFIS).

Method and Materials: An ANFIS is a technique developed for modelling a special type of FIS originally introduced by Sugeno [1]. The Sugeno-type FIS has similar structure as the conventional Mamdani-type FIS, and can update itself based on the observation data. Without the prior planner's knowledge, a Sugeno-type FIS can adjust itself to adapt supervising signal, i.e. training data. It is a great leap over conventional Mamdani-type FIS. For experimental purpose, one set of training and testing data were obtained from the observations of the input-output responses of a Mamdani-type FIS previously constructed by human knowledge. Then, the model of Sugeno-type FIS was iteratively adjusted by a gradient-descent algorithm. As learning procedure was completed, it was examined by the testing data and the error between the outputs of Sugeno-type and Mamdani-type FIS was evaluated.

Results: With the same training data set and testing data set for both systems, the discrepancy between the outputs of Sugeno-type FIS and Mamdani-type FIS is within 2% and varies by 3%.

Conclusion: With adequate training data and training epoch, the Sugeno-type FIS can effectively approximate the function of Mamdami-type FIS. The result indicates that it is possible to build a self-learning AI system for parameter optimization of IMRT treatment planning.

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[1] Jyh-Shing Roger Jang, "ANFIS: Adaptive-Network-based Fuzzy Inference Systems", IEEE Trans. on Systems, Man and Cybernetics, May 1993.