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# Image guided treatment planning system for percutaneous radio frequency ablation

**Hongliang Ren and Wan Cheng LIM**
National University of Singapore, Singapore

Compared with surgical resection of tumors, percutaneous radiofrequency ablation (RFA) has emerged as a viable minimally invasive technique for the treatment of cancers in organs, such as bone, lung or liver. The tumor ablation procedure employs needle-like probes which can be inserted percutaneously to the target tumor and deliver 'burning heat' to kill the cancerous tissue. The current practice of ablation planning is highly dependent on the operator's experience from looking at the preoperative or intra-operative images. Its success rate is greatly influenced by the biological conditions (critical surrounding organs, tumor size), thus the need for computer-assisted interventions to provide a more comprehensive description of the surgery. For large tumors that cannot be completely killed by one ablation even with large electrodes, multiple ablations are needed to cover the whole tumor and a safety margin. To address these challenges, we present a computer-assisted imaged-guided planning system incorporating mathematical optimization and augmented reality. Sphere covering optimized by genetic algorithm are used for complete tumor coverage planning; voxels and optimization equations are employed to calculate optimized needle trajectories. The patient specific model are derived from the dignostic CT images with the safety margin, then the treatment optimization module derives optimal probe insertion trajectories as well as optimal placement locations of ablation electrode. The optimization formulation is structured to satisfy the constraints of complete tumor coverage using multiple overlapping ablations, starting from specified entry points, avoiding critical no-fly zone, while minimizing the number of ablations and skin punctures. The proposed multiple-objective optimization for probe insertions incorporates both clinical and technical constraints and has been validated in the experiments.

## Biography

Hongliang Ren is currently an Assistant Professor and a PI of medical mechatronics in National University of Singapore (NUS). He received his Ph.D. in Electronic Engineering from The Chinese University of Hong Kong (CUHK), and conducted postdoctoral research in the The Johns Hopkins University, Surgical Innovation Institute of Children's National Medical Center, and the Pediatric Cardiac Bioengineering Lab of Children's Hospital Boston & Harvard Medical School. His research interests are in Computer-Integrated Surgical (CIS) systems, biomedical mechatronics, medical robotics and sensing technologies.

ren@nus.edu.sg