Niche researches between computational image analysis and radiotherapy physics

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The biological effect of radiation was recognized as a beneficial potential for treatment of malignant tumor after W.C. Röntgen had discovered x-ray in 1895, which may be considered the birth of radiation therapy and medical physics. Medical physics is a multidisciplinary field, which is an overlap field of physics, medicine, mathematics, engineering, and so on, as shown in Fig. 1. Medical physics field seems to be dependent on the other fields. However, since medical physics field is being created by many researchers all over the world who want to do "niche" researches, the academic subject may not have own field so far. Nevertheless, it has been proved that the outcomes from medical physics are useful in clinical practice.

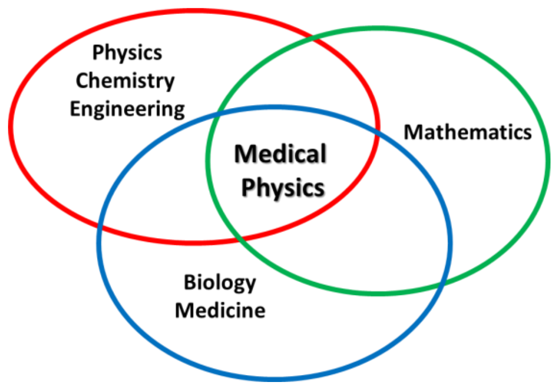

Fig.1 What is medical physics?

What are mainly required in radiation therapy from medical physics point of view are: high conformity of dose distributions to tumor volumes, decrease of normal tissue doses, and accurate tumor localization. For achieving these major requirements of radiation therapy, "harmonious relationships" between computational image analysis and radiotherapy physics have been built.

The laboratory of the author has focused on a niche research field bridging between computational image analysis and radiotherapy physics to increase the accuracy of radiation therapy. Since the author need much knowledge for performing niche researches, the author's policy is "*Knowing something for many things is much better than many things for something. Multifaceted knowledge is best!"* (quote from Blaise Pascal) In the author's presentation, he introduced six niche studies on how computational image analysis can give beneficial impacts on radiotherapy physics as follows.

1. *Computational anatomy* and an automated determination of planning target volume margin to tolerate uncertainties which may occur in radiation therapy [1]
2. *Principal component analysis* and an analysis of inter-observer variation for tumor contours determined by radiation oncologists [2]
3. *Machine learning* and an automated approach for classifying given pixels into tumor and normal tissue pixels [3]
4. *Active contour model based on analytical mechanics* and an automated estimation of tumor contours to reduce the inter-observer variations [4]

5. *Similar cases* and an automated radiation treatment planning to mitigate treatment planning variability (Fig. 2) [5]
6. *Machine learning* and prediction of esophageal stenotic ratios after radiation therapy [6]

The author would be very happy if my presentation is helpful to understand niche researches or medical physics researches to improve the quality of radiation therapy.

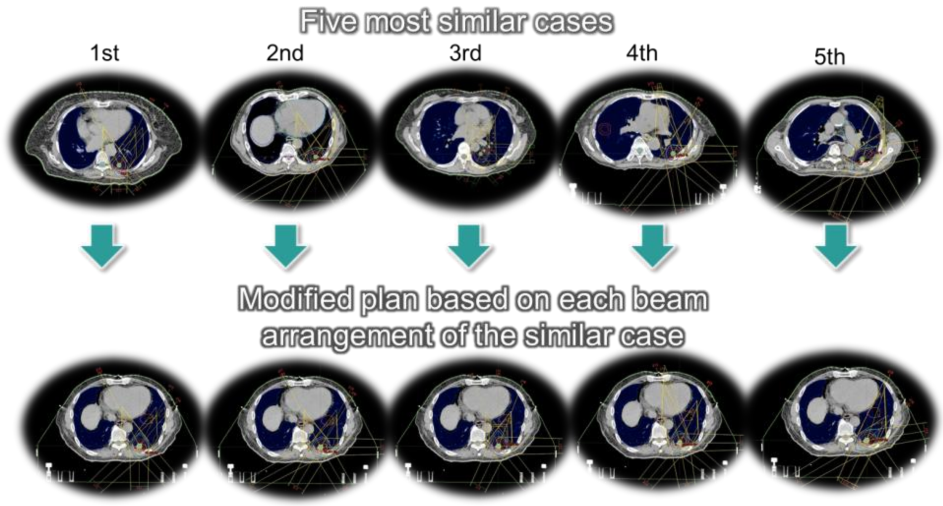

Fig.2 Similar-case-based radiation treatment planning approach.

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