

Announcing the Final Examination of Mahboob ur Rehman for the degree of Doctor of Philosophy in Physics

Date: April 07, 2021

Time: 4:00 p.m.

Zoom link: <https://ucf.zoom.us/j/97863574974?pwd=ay9GN3d1YS9abWJDbmVZYVdYZWNIQT09>

Meeting ID: 978 6357 4974

Passcode: 613600

Dissertation title: Enhancement and evaluation of proton pencil beam spot placement algorithms

Abstract:

Intensity modulated proton therapy (IMPT) has shown improvement in treatment plan quality as compared to conventional proton and photon-based radiotherapy techniques. However, in IMPT maintaining a sharp lateral dose falloff is crucial for sparing organs at risk (OARs), especially when they are in close proximity to the target volume. The most common approach to improve lateral dose falloff is through the use of physical beam shaping devices, such as brass apertures or collimator-based systems. In this work, it has been demonstrated that IMPT dosimetry can be further improved by implementation of advanced spot placement techniques. In the first part of this work, we have developed a novel optimized spot placement algorithm that provides robust spot distributions inside the target. We made use of circle packing, triangulation and geometric construction techniques in other fields and developed a unique spot placement technique that provides both high conformality and uniformity in a robust manner for arbitrarily complex target geometries.

In the second part of the project, we performed a dosimetric comparison of the treatment plans using five different spot placement techniques. The novel optimized spot placement technique developed by us is shown to provide robust treatment plans with improved target coverage, homogeneity of dose, and minimal spots count. These results highlight that plan quality may be improved for many patients, without the need for expensive delivery equipment updates, simply by providing additional spot placement techniques in commercial treatment planning software.

Outline of Studies:

Major: Physics/Medical Physics

Educational Career:

M.S. University at Albany SUNY, New York, USA, 2015

M.S. Medical Physics, Pakistan Inst. of Eng. & Appl. Sciences, Islamabad, Pakistan, 2004

Committee in Charge:

Dr. Talat S. Rahman (Chair)

Dr. Omar A. Zeidan (Co-Chair)

Dr. Kevin Erhart (Member)

Dr. Sanford Meeks (Member)

Dr. Bo Chen (Member)

Dr. Anikett Bhattacharya (Member)

Dr. Elena Flitsiyan (Member)

Approved for distribution by Dr. Talat S. Rahman, Committee Chair, on March 29, 2021.

The public is welcome to attend remotely.