

3D robotic platform that can simulate human lung motion during breathing can deliver focused radiation to cancer patients

Doctors in India may soon have the facility to simulate the lung motion of a cancer patient to help deliver focused radiation in the upper abdomen or thoracic region.

Breathing motion is a hurdle for delivering focused radiation dose to the cancer tumour attached to upper abdomen and thoracic regions. The motion exposes an area larger than the tumour to radiation during cancer treatment, thus affecting tissues surrounding the targeted tumour. A focused radiation for a patient could be customised by simulating the lung movement of the particular patient and then orienting the delivery of the radiation so that it can be effective with minimal dosage. Before this is done on a human, its effectiveness needs to be checked on a robotic phantom.

Recent technological development have resulted in state-of-the-art motion management techniques like-gating and tracking. Though there is incremental development in radiation therapy delivery of respiratory moving targets, the quality assurance (QA) tools have not been developed in parallel. For quantitative determination of the absorbed dose in an organ in the patient for a specific type of treatment procedure accuracy of respiratory motion management techniques, additional respiratory motion phantoms are required.

A group of Indian scientists have developed a novel and cheap 3D robotic motion phantom that can reproduce the lung motion of a human during breathing. The phantom is part of a platform not only emulates the human lung motion as a patient is breathing but can also be used to check if the radiation is being correctly focussed on a moving target. The phantom is placed inside a CT scanner on the bed in place of the human, and it emulates human lung motion as it is irradiated during therapy. During irradiation, consistently high-quality images of advanced 4D radiation therapy treatments are obtained with minimum exposure of the patients and workers. Before the targeted radiation is delivered to a human subject, its effectiveness in focusing only on the tumor is checked with this phantom.

Professor Ashish Dutta, Professor at IIT Kanpur, along with Professor K. J. Maria Das, Professor from Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow developed the programmable robotic motion the platform for the quality assurance of respiratory motion management techniques in radiation therapy.

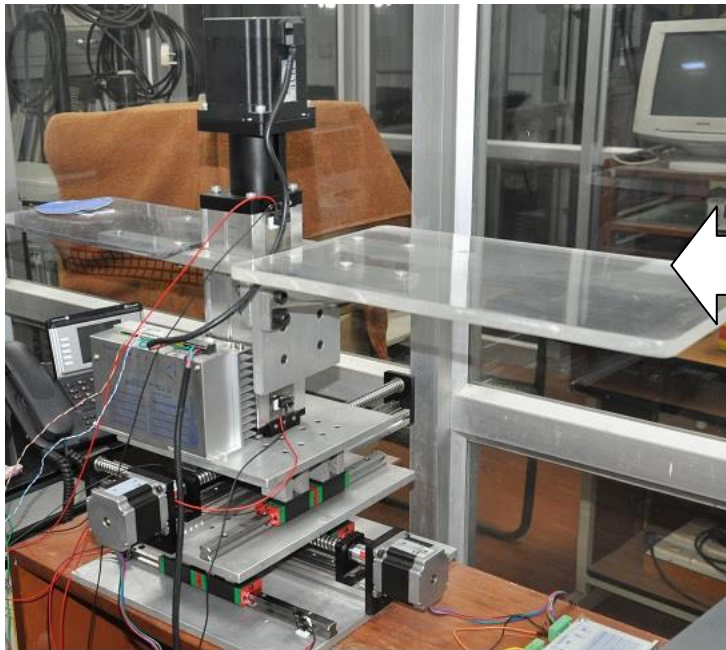
The major part of the phantom is a dynamic platform over which any dosimetric or imaging quality assurance devices can be placed, and the platform can mimic 3D tumor motion by using three independent stepper-motor systems. This platform is placed on the bed where the patient lays down during radiation therapy. As phantom emulates the lung movement, a moving or gating window is used to focus the radiation from the radiation machine on the moving tumour. Detectors placed in the phantom help detect whether the radiation is localised on the tumour.

The dose effectiveness is checked during therapy. The researchers are in the process of testing the system on a phantom. Once done, they will test it on human beings.

This is the first time in India for manufacturing this type of robotic phantoms, and it is more affordable than other imported products available in the market as the program can be changed to produce different types of lung motion.

The technology developed with support from the Advanced Manufacturing Technologies programme of the Department of Science & Technology (DST), Government of India, and aligned with the 'Make in India' initiative is currently under final testing in SGPGIMS, Lucknow.

The innovators are further trying to commercialize the product, which can be used in place of the overseas model that is very much more expensive and does not give access to the control software.



An artificial lung with a tumor inside or a set of radiation detectors will be placed on this table and it will be moved to emulate human lung tumor motion while it is being irradiated.

Fig. 1. 3 Axes X-Y-Z motion platform that can move the platform to copy the lung tumor motion during human breathing.

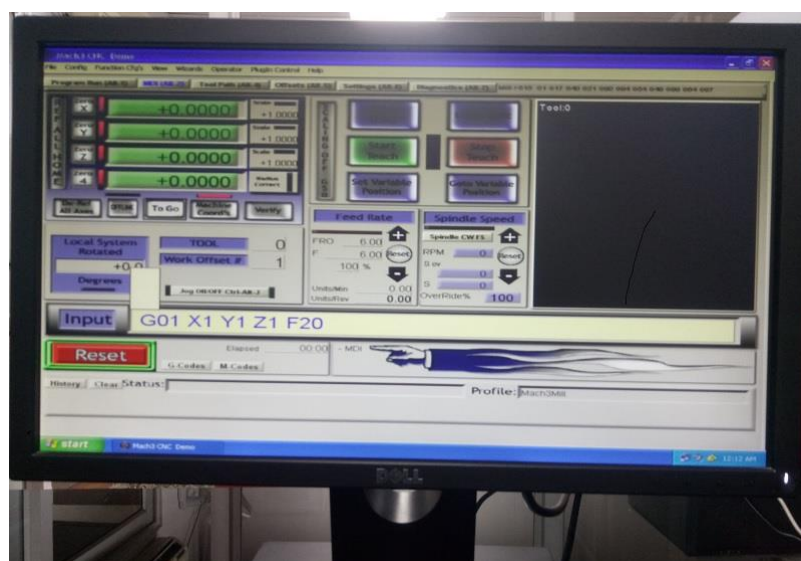


Fig. 2. Software to program the motion of the robotic phantom to produce human lung-like motion.

For more details, Prof. Ashish Dutta (9621488633, adutta@iitk.ac.in) can be contacted.