A Pediatric Simulated Dosimetry Platform for Clinical Use

Organizations

IKH is an SME and a regional leader in large-scale ICT solutions in the fields of: Digital Government, Digital Health, and Industrial Innovation & Robotics.

BIOEMTECH is an SME in the field of biomedical engineering offering hardware solutions for medical imaging and dosimetry applications.

GRNET provides networking and cloud computing services to a broad range of public and private sectors.

| End User	Domain Expert & End User	HPC Expert
IKH	⌀BIOEMTECH	grnet

Partner GRNET is part of the NCC Greece.

The Challenge

Radiation dose calculations from radiopharmaceuticals in nuclear imaging like PET (with applications in oncology, neurology or cardiology) have been a challenge to the scientific community and the clinicians, as no commercial solutions for personalised dosimetry existed so far. In particular, developing and optimising dosimetry protocols in pediatric applications are of great social interest in the worldwide health community as children are much more sensitive to ionising radiation than adults.

Currently, in clinical practice, there are only rough estimations for the optimal dose that a child should receive. Obtaining improved dosimetry protocols for children is difficult through standard clinical practices such as experimental dosimetry and validation. Related to the stochastic nature of nuclear radiation, statistical computing approaches like Monte Carlo simulation can provide ground truth for dosimetry, but are a challenge to integrate into clinical practice, due to their computational cost among other reasons.

Current solutions and the traditional approaches lack personalisation of dose assessment on a patient basis. There is an opportunity to penetrate the clinical dosimetry software market, but this requires multidisciplinary effort and access to advanced computing facilities, to overcome both the missing personalisation and the practical limitations of using compute-intensive methods in clinical practice.
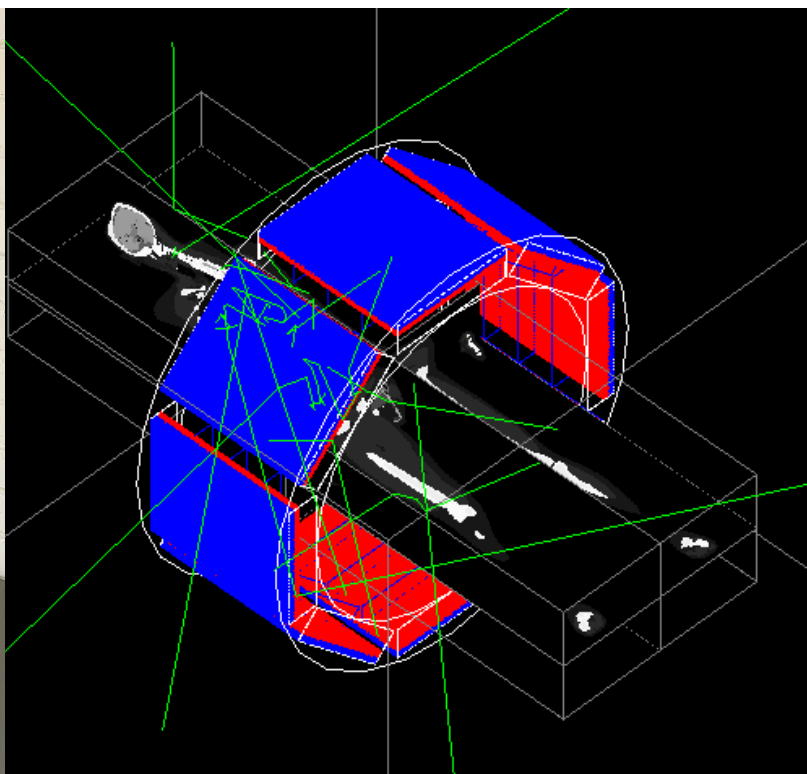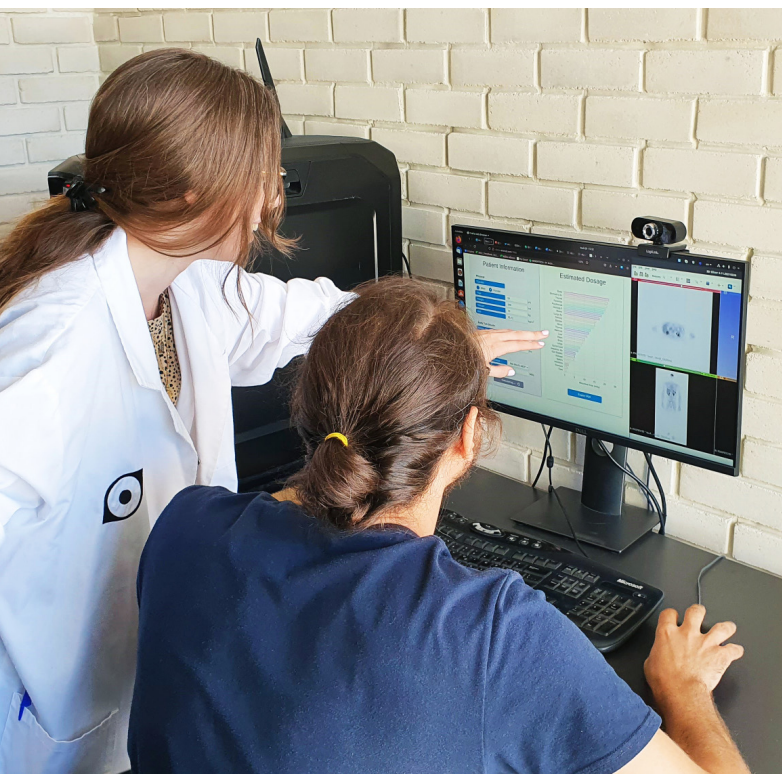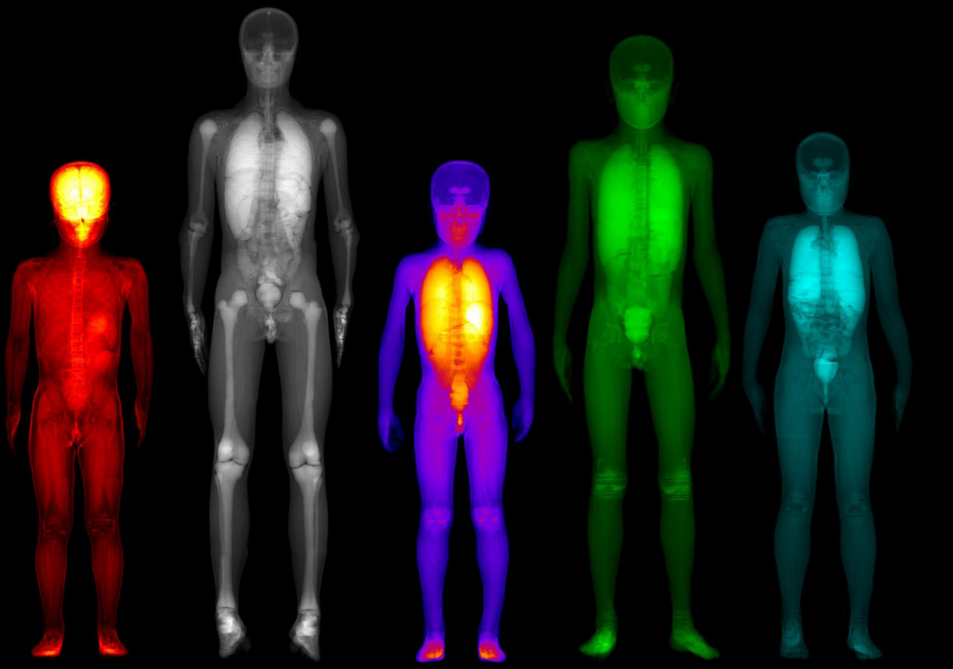
The Solution

In order to tackle the challenge, partners exploited all the appropriate tools for creating a precise dosimetry software ("PediDose") to accurately evaluate the absorbed dose at organ level.

The resulting software allows clinicians to assess internal dosimetry and optimise Nuclear Medical imaging clinical protocols toward personalised medicine. In order to obtain a realistic simulated dosimetry database, Monte Carlo simulation was applied to about 30 advanced anthropomorphic phantoms covering 31 organs. By employing HPC resources, a speedup by a factor of 80 was achieved, permitting a high level of accuracy in predicting the absorbed doses of radiation in these organs. Subsequently, a predictive dosimetry model based on machine learning algorithms was developed and trained with these computed results, permitting an individual dose calculation for each new pediatric patient, taking into account their personalised anatomical characteristics.

The Impact

PediDose is expected to significantly strengthen IKH and BIOEMTECH in the EU industry of medical software and provide these SMEs with great advantages in this highly competitive area, addressing both the European and US Market.

PediDose has been technically integrated into the evorad® suite, a competitive healthcare software for medical imaging by IKH. After further maturation and obtaining the CE Mark and FDA approval, this add-on is expected to generate additional net income for IKH of about €1.25 Mio within the next five years.

PediDose will be offered on a license basis to other vendors of medical software. Further business opportunities are anticipated in an extension of the approach for adult patients or specific groups like obese patients or pregnant women.

PediDose will permit BIOEMTECH to enter the medical software market through a business partnership with IKH and utilise the existing customers of BIOEMTECH's imaging devices for extending its portfolio.

Personalised dosimetry supported by PediDose can lower administered doses and minimize radiation's harmful effects for a very large number of treated children (11% of the Nuclear Medicine departments perform more than 1,000 pediatric studies per year). The proposed solution provides a great potential for expansion to other patient groups, utilising the developed methodology.

Benefits

- Significant strengthening of the value proposition for IKH's product Evorad® achieved.
- €1.25 Mio additional total income expected through increased sales of Evorad®.
- Medical market entry for BIOEMTECH facilitated through partnership with IKH.