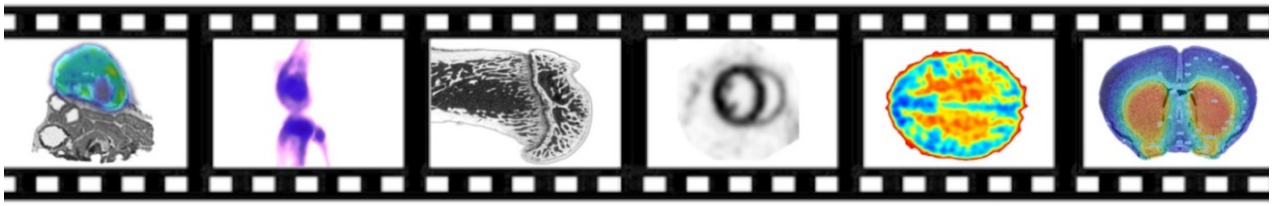
VECTor/CT: Versatile and adaptive ultra-high resolution & sensitive molecular imaging platform with concurrent PET-SPECT capabilities.

Frederik Beekman Ph.D., Delft University of Technology / MILabs



Abstract

Pivotal questions in biomedical research concern how the function of localized cells relates to disease, and how these processes can be visualized and affected by exogenous molecules in-vivo, in mice and men. In order to accomplish this, we have aspired to have a magnifying glass that would allow us to e.g. see neurotransmitters in action, or simultaneously quantify mechanical function, blood perfusion and local cell functions in the heart, or in cancer research for visualizing distribution dynamics of pharmaceuticals and quantifying tumor responses.

In recent years many groups have been involved in the development of adaptive nuclear imaging systems for rodents. At MILabs and TU-Delft, Ultra-high resolution Single Photon Emission Computed Tomography (U-SPECT/CT) systems have been designed for quantitative imaging of functional processes in structures smaller than a quarter mm, to enable low dose imaging at the sub-MBq level, or to obtain extremely fast dynamic SPECT, virtually in real-time. These developments include highly advanced collimators as well as novel image acquisition and reconstruction methods. In addition, a device to simultaneously perform sub-mm Positron Emission Tomography (PET) and SPECT on co-injected tracers has been developed. This *Versatile Emission Computed Tomography* system (the "VECTor") is based on innovative clustered multi-pinhole technology. With PET and SPECT perfect temporal and spatial registered new molecular imaging explorations are enabled to study different molecular mechanisms and pathways in the living animal under similar

physical and physiological conditions.

In this presentation, several scientific results recorded by world wide users of U-SPECT/CT and VECTor/CT will be shown, such as ultra-high resolution images of glucose and density and occupancy of transporters/receptors in the brain, very detailed in-vivo images of myocardial perfusion (simultaneously with metabolism and mechanical function), tumor markers, theranostic applications to monitor and guide cancer therapy in real-time, as well as longitudinal imaging of very low amounts of cells or molecules. In addition, multimodal platforms combining SPECT, PET, Optical (bioluminescence and fluorescence) and Ultra-high performance X-ray CT (U-CT) will be discussed, plus the first successful steps made to translate MILabs technology into G-SPECT*, an ultra-fast, ultra-high < 3mm resolution clinical imaging system that is expected to have a game-changing effect on molecular imaging for translational research and clinical diagnostics applications.

* In 2015, MILabs' G-SPECT received the "WMIS innovation of the Year 2015" award

Curriculum Vitae

Prof. Frederik J. Beekman heads the section Radiation, Detection & Medical Imaging at TU Delft University. He co-authored 135 journal papers and is the inventor on 31 patents. Dr. Beekman was honored with several awards for his contributions to SPECT and PET technology and its application in biomedical research. His research interests include radiation technology applied to medicine and biomedical science and image reconstruction from projections. He is an associate editor of several journals and board member of Physics in Medicine & Biology. He is founder and CEO/CSO of MILabs (www.milabs.com) that develops and markets high performance molecular imaging systems.