

# MASTER THESIS PROJECTS @ IFAE Medical Imaging

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**TITLE:** Title : Calibrations of X-ray Spectral Photon counting detector

**SUPERVISOR:** Supervisor: Mokhtar Chmeissani

**RESEARCH GROUP:** Research group: IFAE-Medical Imaging

**PROJECT DESCRIPTION:** Project description: IFAE has developed a dedicated X-ray spectral photon counting detector, using pixel CdTe detector bump bonded to dedicated frontend pixel ASIC. The pixel has 6 energy levels but due to some offsets and gain spread, these 6 energy levels varies from one pixel to another. However in every pixel and for every threshold there is an adjustable voltage correction to tuned all the trigger levels to be equally for all the pixels. After achieving this equalization point, one can take X-ray images of different object with different densities and can detect minute difference. Then the detector is mounted on a linear motor, it can be used as X-ray scanner to scan large object, like the ones used in the airports

The Master Student will be introduced to photon counting pixel CdTe detector, how it operates and detects X-ray photons, how the X-ray image is formed, and latter how it is analyzed. The master student will have to learn how to program with Labview. The basic program exist but it needs more development. He/she will be taught how the pixel frontend readout electronics works to have good understanding how to equalized all the thresholds for all pixels.

**KEYWORDS:** Keywords: Labview, Photon Counting, X-ray imaging, data-analysis

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**TITLE:** Title: Positron Emission Tomography (PET) data collection and analysis

**SUPERVISOR:** Supervisor: Mokhtar Chmeissani

**RESEARCH GROUP:** Research group: IFAE-Medical Imaging

**PROJECT DESCRIPTION:** Project description: IFAE has built a novel PET using pixel CdTe. The project is called Voxel Imaging Pathfinder PET (VIP-PET). With pixel CdTe one can get the exact position of the impact of the gamma photon and its energy. But sometimes the gamma photon undergoes a Compton scatter process and deposit its energy in two different pixels. Given we know the position and energy precisely, one can reconstruct the Compton cone.

The Master student will be introduced to pixel CdTe detecto used in VIP-PET and what are the critical parameters. The research work will cover the physics of gamma photons detection and scattering in CdTe and how to compute the Compton cone and how to detection the origin of the gamma source. The intersection of 3 Compton cones will allow

the determination of the point source. The master student need to develop a code using Mathematic to find the best common intersection point for Compton Cones. If time permit, the master student will learn learn as well how to program with Labview.

**KEYWORDS:** Keywords: Labview, PET, pixel-CdTe, Compton

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**TITLE:** Title : Calibrations of X-ray Spectral Photon counting Camera for breast biopsy

**SUPERVISOR:** Supervisor: Mokhtar Chmeissani

**RESEARCH GROUP:** Research group: IFAE-Medical Imaging

**PROJECT DESCRIPTION:** Project description: IFAE is developing a dedicated X-ray spectral photon counting detector 6 cm x 6 cm, using pixel CdTe detectors. The final use of this camera is in medical application, and mainly for breast biopsy prone table. The camera has around 250k pixels that have to be equalized and calibrated for gain variation and baseline offset. After achieving this equalization point, one can take X-ray images of the same object at different angle and with these X-ray images one can reconstruct a pseudo 3D image. This will allow the precise guiding of the biopsy needle toward a specific target point inside the breast tissue.

The Master student will be introduced to photon counting pixel CdTe detector operates, detects X-ray photons, and how the images are formed. The master student will learn how to do basic programs with Labview. He/she will be taught how to analyse the data, correct for dead pixel and equalized the pixel response. The test will be done with phantom breast.

**KEYWORDS:** Keywords: Labview, Photon Counting, X-ray imaging, breast-biopsy

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