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X-ray Single-Pixel Imaging with MPGD-based detectors

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X-ray imaging is an invaluable tool for noninvasive analysis in many fields ranging from basic science to medicine and security. The development of low-dose large area imaging solutions still represents an important challenge for various applications.

One solution to the imaging of large areas lies in the development of novel computational imaging systems that can overcome the limitations imposed by hardware, relying instead on numerical processing power. The single-pixel detector, depending on the application, may offer a competitive edge over conventional cameras (being a cheaper alternative to the multi-pixelated solutions). In addition, the single-pixel detector can be used to achieve improved detection efficiency, faster timing response, and good spatial resolution with low radiation dose. Moreover, this technique enables detectors to image through diffuse mediums, increasing the image quality at significant depths, solving the depth penetration issues of other imaging methods.

Another advantage of single pixel imaging is that it can be combined with compressive sensing, which significantly reduces the data storage and data transfer requirements, an important consideration for remote sensing applications or when the problem is high dimensional such as hyperspectral imaging.

In this work, we explore the application of single-pixel imaging techniques to produce two-dimensional images with high temporal resolution, using only a single detector (bulk detector). The setup, based on the application of Hadamard patterns, showed promising results, proving the ability of the system to acquire images using thin PLA based masks (up to 5 mm thickness). Both simulation, using GEANT 4, and experimental setup, based on a time projection chamber (TPC), used in this work to demonstrate this technique will be reported here along with the first results.

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