

Research: An agent-dependent enhanced optical projection tomography-guided system for lymph-node images reconstruction to optimize cancer detection.

I worked in Dr. Ken Tichauer's lab, and the ADEPT system was designed and presented in the dissertation of Dr. Veronica Torres. Thank you, Dr. Ken, Dr. Veronica, Mr. Cody Rounds, and everyone in the lab for the opportunity and the assistance.

Introduction:

Cancer continues to be one of the leading causes of death worldwide. As of 2020, 1,806,590 new cancer cases and 606,520 cancer deaths were recorded in the United States [1]. As a result, it is critical to developing techniques/technologies to assist surgeons in making fast and accurate decisions of whether to do more removal of tumor-draining lymph nodes while operating cancer surgeries. The agent-dependent enhanced optical projection tomography (ADEPT) system is a technology combining advancements in two areas. First is the optical projection imaging. The second is the “paired-agent” molecular imaging [2]. These attained images were transferred to the ADEPT-GUI system subsequently to reconstruct images. Physicians could then quickly check the tumor-draining lymph nodes and conclude whether to continue the operation.

Methods:

Filtered back-projection (FBP): FBP is a common analytical reconstruction method that helps regenerate an object's image while decreases embedded noises. The process is comprised of two parts, the filtered phase and the back-projection phase. Back-projection is the act of smearing different obtained 2D images at their taken angles. Filtered is then being added to the process to sharpen the images. Lastly, the sinogram will be inverted back through the built-in MATLAB iradon() function. The reconstruction operation is completed.

Maximum-likelihood expectation-maximization algorithm (MLEM): MLEM is the algorithm frequently used in reconstructing images. Usually, there is an initial estimated image to start off the reconstruction. However, the computation is inherently slow. Therefore, our system has integrated FBP as the initial point of the MLEM technique to accelerate the reconstructing procedure. This combination enhances both the speed of the system and the quality of the images.

Results, analysis, and discussion:

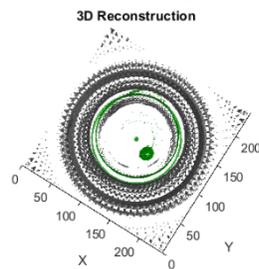


Figure 1 shows the ADEPT-GUI's ability to reconstruct a clear and sharp image of a lymph node contained a tumor. Although FBP is an excellent tool for image reconstructions, it is not clear enough for the physicians to determine whether the small thing is either artifact or a tumor. MLEM, on the other hand, has improved the image's quality so that the surgeons could make reliable decisions.

Figure 1

Conclusion:

Compared to the MLEM technique, adding FBP into the procedure strengthens the system's ability. The ADEPT-GUI system shows a strong image reconstruction capacity and will be developed to optimize cancer detection.

References:

[1] Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. *CA Cancer J Clin.* 2019;69(1):7-34. doi:10.3322/caac.21551.

[2] Veronica C. Torres, Chengyue Li, Jovan G. Brankov, and Kenneth M. Tichauer, "Model-based system matrix for iterative reconstruction in sub-diffuse angular-domain fluorescence optical projection tomography," *Biomed. Opt. Express* 12, 1248-1262 (2021).