Quantitative Fluorescence Tomography Validated with Automated Registration to 3D Volumetric CT Data

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Abstract
Fluorescence tomography in small animals is a valuable tool for monitoring biological events such as disease progression and drug targeting efficiency through the use of fluorescent proteins and/or conjugated dyes. We discuss recent developments in our instrumentation and tomographic reconstruction algorithms, as well as the use of a microCT scanner to assess the accuracy of the tomographic solution to fluorescent source distribution in a 3D volume. The use of automated registration algorithms allows for precise alignment of optical and CT data, which is valuable for tracking of fluorescent sources in mice.

In Vitro Measurement

Fig. 1. Example dual modality optical and CT images acquired from the experimental setup. The fluorescent dye Qtracker 670 was imaged with a FLIT system, and the corresponding CT slice is overlaid on the right side of the figure. The fluorescent dye is deposited into a well of the 96-well plate, and the corresponding slice is extracted from the microCT scanner.

Experimental Results

Fig. 2. FLIT reconstruction of a well containing the fluorescent dye Alexa Fluor 488. The dye concentration was measured to be 100 nM, and the corresponding optical and CT images are displayed on the left and right sides of the figure, respectively.

Volumetric Registration to Optical Imaging Data

Fig. 3. Set limits for CT-FLIT volumetric registration to optimize the alignment of the two datasets. The upper limit is set to the maximum limit of the CT data, and the lower limit is set to the minimum limit of the FLIT data. The resulting registration is displayed on the left side of the figure, with the corresponding CT slice on the right.

Conclusions

Automation and integration of registration algorithms is essential for quantitative analysis of fluorescence in small animals. The use of automated registration algorithms allows for precise alignment of optical and CT data, which is valuable for tracking of fluorescent sources in mice.

References

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