Optimal self-calibration of tomographic reconstruction parameters in whole-body small animal optoacoustic imaging.

In tomographic optoacoustic imaging, multiple parameters related to both light and ultrasound propagation characteristics of the medium need to be adequately selected in order to accurately recover maps of local optical absorbance. Speed of sound in the imaged object and surrounding medium is a key parameter conventionally assumed to be uniform. Mismatch between the actual and predicted speed of sound values may lead to image distortions but can be mitigated by manual or automatic optimization based on metrics of image sharpness. Although some simple approaches based on metrics of image sharpness may readily mitigate distortions in the presence of highly contrasting and sharp image features, they may not provide an adequate performance for smooth signal variations as commonly present in realistic whole-body optoacoustic images from small animals. Thus, three new hybrid methods are suggested in this work, which are shown to outperform well-established autofocus algorithms in mouse experiments in vivo.