Ultrasound localization microscopy and phase aberration correction for transcranial vascular imaging in humans

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Abstract: The skull bone is a well-known obstacle for ultrasound imaging, as it attenuates and distorts acoustic waves, and makes transcranial imaging extremely difficult or even impossible. Microbubbles used as contrast agents strongly enhancing blood signal, and the recent advent of ultrasound localization microscopy have changed this paradigm, allowing the visualization of the brain vasculature at high spatio-temporal resolution. Bubble localization is however still impeded by skull-induced phase aberrations, that degrade the system point-spread function, which in turn becomes difficult to represent with a simple physical model. Here, we propose to use the coherent wavefronts backscattered by the microbubbles and a method based on the singular value decomposition of radio-frequency signals to automatically identify aberration laws in different isoplanetic patches of the field of view. This allowed the reconstruction of corrected images, in which more microbubbles can be localized.