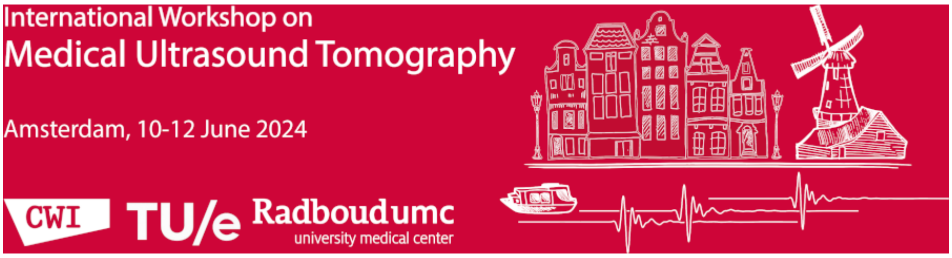

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A Calibration Algorithm for a Large Circular Array of Ultrasound Transducers

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We consider a planar circular array of a large number of ultrasound emitter-receiver elements. Due to unavoidable inaccuracies of the manufacturing process, the actual positions of the elements slightly differ from the ideal equidistant positions on the circle; also, there exist delays in emitting and receiving the signals. For every emitter-receiver pair available are the accurate enough measurements of the time between the instant of activation of an emitter and the instant of registration of the signal by a receiver, and this is the only information we possess. The inaccuracies mentioned above lead to incorrect evaluation of the actual time-of-flight of the signals and to corrupted resulting ultrasound pictures, so that the numerical values of the misplacements and delays are to be evaluated. This procedure is referred to as *calibration*.

The existing approaches either recast this problem into a certain convex optimization setup based on use of distances between the elements, or work directly with the coordinates. In the former case, the dimension of the problem (number of variables, size of constraints) becomes huge, which severely complicates data storage and the solution itself. In the latter case, the problem is nonconvex, so that only local minima (i.e., suboptimal solutions) can be found.

In this note we propose a very simple iterative procedure to solve this calibration problem. At every iteration, we first optimize over a part of variables (namely, delays) and then use their updated numerical values to optimize over the rest of the variables (coordinates). With a simple trick, both optimization problems are converted into linear ones leading to moderate-sized linear programs. This makes the overall algorithm really fast even for very large arrays. Preliminary experiments testify to a rather promising performance of the method.

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