# Review of TUFFC-05732-2013: "Coherence-weighted synthetic focusing applied to ultrasound and photoacoustic imaging using a high-frequency annular-array transducer"

## I. Summary

The authors present an adaptive synthetic focusing scheme applied to an annular array to improve focusing and enhance both spatial resolution and contrast. The effectiveness of the scheme is demonstrated using an experimental setup.

While most of the results seem convincing, I have a few concenrs that mus be adressed if this paper is to be published. I have divided my concerns into two lists; one containing major concerns that I believe must lead to revision, and one concerning minor concerns that may be only my personal opinions.

## II. Major concerns

**1)** I am a bit concerned about the authors' characterization of their contribution. Reading the abstract and the conclusion, they describe their contribution as the development of a "scheme" or a "protocol". However, at the end of the introduction, it seems to me that they are simply applying unmodified CF weighting to improve an already tested and reported technique. Unless there is some reason that CF weighting should not work in this case, the reported improvements are as expected from what we already know about CF processing and not very surprising. In my opinion, this means that the novelty of the contribution is not large enough to warrant publication as a full paper and the authors should resubmit the revised paper as a technical correspondence. In any case, the authors should be more consistent with how they describe the nature of their contribution, especially in light of their previous publications on related matters.

**2)** It is problematic to infer the resolution of the DAS+CF beamformer from its response to a single scatterer. This is because, unlike DAS, the DAS+CF beamformer is adaptive in a way that does not follow the principle of superposition. In other words; if there were another point scatterer located close to the imaged point scatterer, then the additional attenuation offered by CF would be reduced in a non-linear way. This should be investigated further, and mentioned in connection with the resolution-related results.

## III. Minor concerns

**1)** I would rather see Eq. (1) and the theory behind CF explained as part of Sec. II.

**2)** After Eq. (1), the authors state that the CF-weighted DAS approach significantly "reduces incoherent noise and signals originating from off-axis positions (...)", which could be misinterpreted as an improvement of per-pixel SNR by reducing noise/interference while keeping the signal intact. In reality, CF-weighting only suppresses parts of the image inversely proportional to their coherence. In other words, wherever noise is reduced, signals are similarly reduced. The explanation of CF weighting could be edited to include a more thorough explanation of its workings.

**3)** Why was the CF map smoothed with a median filter, and what would the results be without this smoothing? Please elaborate.

**4)** The change in speckle characteristics, as well as other image artifacts, are well-known in the CF literature. Existing techniques for managing this are the Generalized Coherence Factor (Li and Li, "Adaptive Imaging Using the Generalize Coherence Factor") and Scaled Wiener Filters (Nilsen and Holm, "Wiener Beamforming and the Coherence Factor in Ultrasound Imaging"). I was wondering whether the authors have applied any of these techniques, or if this could easily be done?

**5** Reference [18] does not have anything to do with CF imaging, as it solely focuses on Minimum Variance adaptive beamforming.

## IV. Conclusions

The authors should address my concerns about their conclusions on the resolution improvement of DAS+CF, and they should evaluate whether their contribution is novel enough to constitute a full paper or a technical correspondence.