Additional results for "Joint entropy of continuously differentiable ultrasonic waveforms" [J. Acoust. Soc. Am. 133(1), 283-300 (2013)]

M S. Hughes  
Washington University School of Medicine in St. Louis

J N. Marsh  
Washington University School of Medicine in St. Louis

S A. Wickline  
Washington University School of Medicine in St. Louis

John E. McCarthy  
Washington University in St Louis, mccarthy@wustl.edu

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In this Comment we report on a further improvement in sensitivity of ultrasonic detection of targeted nanoparticle contrast agents in vivo beyond that reported in Fig. 7 of a recent publication in this journal.¹ These results were obtained using the joint entropy, $H_{f,g}$ [Eq. (4) of Ref. 1], of the backscattered radio frequency ultrasound and a reflection of the insonifying pulse, $g(t)$, as a reference waveform.

A theoretical analysis of average performance of this type of signal processing in the presence of Gaussian noise leads to a general strategy for finding a much better choice of reference in many experimental circumstances.² This search requires extensive computer time but results in a further 2.5-fold increase in sensitivity as quantified by the statistical confidence of the measurements means and standard deviations [Eq. (6) of Ref. 1].

All data acquisition and analysis parameters are the same as described previously.¹ The new feature of the analysis presented here is the use of a more nearly optimum reference waveform, $g(t)$, for the computation of joint entropy, $H_{f,g}$.

The reference, $g(t)$, was found by searching for the maximum confidence obtained using step-like functions having jumps at the extrema of the reflection of the transducer insonifying pulse from a stainless steel-reflector. These functions are specified by location of jumps, low-value, and high-value. The search spanned the following parameter ranges. Shift values: from $-0.02$ to $0.10$ in increments of $0.01$, high-values: from $100.0$ to $10000.0$ in decades, low-values: from $0.01$ to $0.001$ in decades values.

The color lookup table of Fig. 1 is chosen to be the same as that of Fig. 7 published previously.¹ However, the confidence values in the panels cover the range $-7.7$ to $30.1$ so that the upper range of values, which appear on the upper right of panel (A) are actually saturated. These are roughly twice the magnitude of the largest confidences ($-16$) obtained previously.¹

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