Appendix of Ultrasound scattering from cell-pellet biophantoms and \textit{ex vivo} tumors provides insight into the cellular structure involved in scattering


I. QUS-DERIVED SCATTERER PARAMETER DISTRIBUTIONS

A. Strategy 2: random noise on BSC

The optically derived scatterer parameters presented in this subsection were obtained using strategy 2: calculated BSCs of mean $a$ and $\phi$ values from optical histology-derived parameters with added noise to mimic experimental BSCs. The figures showing ($a, \phi$) distributions for scattering from cells only, nuclei only and both cells and nuclei for $w=0.5$ and 0.8 ($w=0.2$ for MAT) are in Figures I.1, I.2, I.3 and I.4.

The calculated BSC distributions from cell structures provide $a$ and $\phi$ values similar to those scatterer radii and volume fractions close to cell parameters evaluated optically from histology (Figures I.1B and G, I.2B and G, I.3B and G and I.4B and G). The calculated BSC distributions from nucleus structures provide $a$ and $\phi$ values similar to those scatterer radii and volume fractions close to nucleus parameters (sections 5+3) evaluated optically from histology (Figures I.1E and J, I.2E and J, I.3E and J and I.4E and J). The ($a, \phi$) calculated distributions from both nucleus and cell structures lead to outcomes mainly in sections 5, 4+7 and 3 (Figures I.5C-D and H-I, I.6C-D and H-I, I.7C-D and H-I and I.8C-D and H-I).

The best correlations between the percentage of optically derived scatterers present in each grid section for scattering from cells only, nuclei only and both cells and nuclei with the QUS-derived ($a, \phi$) distribution for each CP and T are summarized in Table IV. The best correlations for the T from all four cell lines are with scattering from nuclei only. The best correlations for 4T1 and LMTK CP are with scattering from both cells and nuclei. The best correlations for JC and MAT CP are with scattering from nuclei only.

B. Strategy 3: random $a$ and $\phi$ values and random noise on BSC

The optically derived scatterer parameters presented in this subsection were obtained with strategy 3: calculated BSCs with random values of $a$ and $\phi$ and noise. The figure presenting the distributions ($a, \phi$) for scattering from cells only, nuclei only and both cells and nuclei for $w=0.5$ and $w=0.8$ (or $w=0.2$ for MAT) are in Figures I.5, I.6, I.7 and I.8.
Fig. I.1. 4T1 cell pellet (top row) and 4T1 tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.5$ and $0.8$ ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 2. The green ($\alpha_N \& \phi_N$) and red ($\alpha_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.

Fig. I.2. JC cell pellet (top row) and JC tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.5$ and $0.8$ ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 2. The green ($\alpha_N \& \phi_N$) and red ($\alpha_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.
Fig. 1.3. LMTK cell pellet (top row) and LMTK tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.5$ and 0.8 ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 2. The green ($a_N \& \phi_N$) and red ($a_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.

Fig. 1.4. MAT cell pellet (top row) and MAT tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.2$ and 0.5 ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 2. The green ($a_N \& \phi_N$) and red ($a_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.
Fig. I.5. 4T1 cell pellet (top row) and 4T1 tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs (BSC_C, second column, B and G), calculated cells and nuclei BSCs for \( w = 0.5 \) and 0.8 (BSC_{NC}, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs (BSC_N, fifth column, E and J) obtained with strategy 3. The green \((a_N \& \phi_N)\) and red \((a_C \& \phi_C)\) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.

Fig. I.6. JC cell pellet (top row) and JC tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs (BSC_C, second column, B and G), calculated cells and nuclei BSCs for \( w = 0.5 \) and 0.8 (BSC_{NC}, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs (BSC_N, fifth column, E and J) obtained with strategy 3. The green \((a_N \& \phi_N)\) and red \((a_C \& \phi_C)\) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.
Fig. 1.7. LMTK cell pellet (top row) and LMTK tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.5$ and 0.8 ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 3. The green ($a_N \& \phi_N$) and red ($a_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.

Fig. 1.8. MAT cell pellet (top row) and MAT tumor (bottom row) scatterer radius versus volume fraction from QUS-measured BSCs (first column, A and F), calculated cells-only BSCs ($BSC_C$, second column, B and G), calculated cells and nuclei BSCs for $w=0.2$ and 0.5 ($BSC_{NC}$, third and fourth column, C, D, H and I) and calculated nuclei-only BSCs ($BSC_N$, fifth column, E and J) obtained with strategy 3. The green ($a_N \& \phi_N$) and red ($a_C \& \phi_C$) dashed lines correspond to the mean optical histology-measured nucleus and cell radii and volume fractions, respectively. CP denotes cell-pellet biophantom and T denotes tumor.