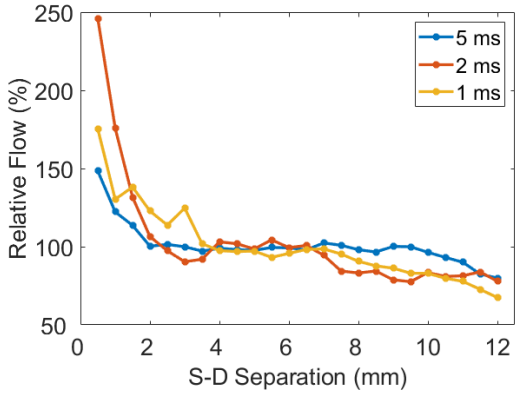
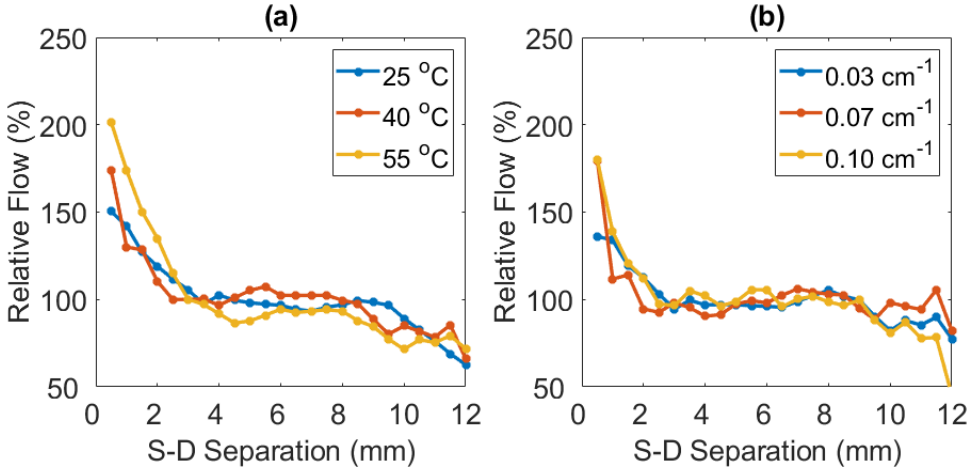
Supplementary Data

We compared our scDCT measurement results in homogenous tissue phantoms at exposure times of 1, 2, and 5 ms (see **Supplementary Fig. 1**). Means ± standard deviations of relative flow values were 99 ± 13%, 95 ± 26%, 102 ± 30% in 5ms, 2 ms, 1 ms, respectively, in 2-8 mm. Data obtained with the exposure time of 5 ms (blue curve) generate the most stable/constant relative flow values at effective S-D separations of 2 to 8 mm.



Supplementary Figure 1: Boundary flow distributions over the selected source (S_2) and left detector array with S-D separations ranging from 0.5-12 mm in a homogenous tissue phantom (see the S-D configuration in **Fig. 3**). Flow indices were normalized to their mean value to generate relative flow values for presentation.

To test the dependence of effective S-D separations on phantom optical properties, we used the scDCT to measure Intralipid particle flow changes due to varied temperatures (25°C, 40°C, and 55°C; **Supplementary Fig. 2a**) and varied tissue absorption coefficient μ_a by adding Indian ink (0.03, 0.07, and 0.10 cm^{-1}; **Supplementary Fig. 2b**). The means ± standard deviations of relative flow were 111 ± 10%, 102 ± 11%, 101 ± 15% respectively with varied temperatures and 103 ± 12%, 108 ± 14%, 105 ± 16% respectively with varied μ_a. Results verify that data obtained at effective S-D separations of 2 to 8 mm are relatively constant and stable.



Supplementary Figure 2: Boundary flow distributions over the selected source (S_2) and left detector array with S-D separations of 0.5-12 mm on homogenous tissue phantoms (see the S-D configuration in **Fig. 3**). **(a)** Intralipid particle flow variations with varied temperatures of 25°C, 40°C, and 55°C. **(b)** Intralipid particle flow variations with varied μ_a of 0.03, 0.07, and 0.10 cm^{-1}.