## Supplementary Information

# Programmable Real-time Clinical Photoacoustic and Ultrasound Imaging System

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**Table S1.** Specifications of commercial photoacoustic/ultrasound imaging systems. PRF, pulse repetition frequency; PA, photoacoustic; and FDA, United States Food and Drug Administration.

| System | Laser source | | Imaging system | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PRF [Hz] | Wavelength [nm] | PA frame rate [Hz] | PA penetration depth [cm] | Ultrasound frequency for PA imaging [MHz] | Transducer for PA imaging | Programmable | User interface for PA imaging | FDA approved |
| **Verasonics** | Laser dependent | Laser dependent | Laser dependent | Laser dependent | Transducer dependent | Linear | Yes | No | No |
| **VevoLAZR (Visualsonics)** | 20 | 680-970 | 5 | 1.5 | 21 | Linear | No | Yes | No |
| **Nexus 128 (Endra)** | 20 | 680-950 | Reconstruction time: < 1 minutes | 1.5 | 5 | Helical | No | Yes | No |
| **MSOT Acuity (iThera)** | 10 or 100 | 680-980 | Up to 50 | 1-3 | 2.5, 10 | 2D array | No | Yes | No |
| **Louisa3D (TomoWave)** | 10 | 532, 730, 850, 1064 | – | – | 4 | Arc | No | Yes | No |
| **PA mammography (Canon)** | 10 | 680-950 | Total scan time: 12 seconds | – | 2 | Hemisphere | No | Yes | No |
| **Twente PA mammoscope (Twente)** | 10 | 1064 | – | – | 1 | Flat | No | Yes | No |
| **Imagio (Seno medical)** | – | – | – | – | – | Linear | No | Yes | No |
| **Prodigy (S-Sharp)** | – | – | – | – | – | – | Yes | No | No |
| **Sonix Touch Q+ (BK)** | – | – | 10 | 3 | 7 | Linear | Yes | No | Ultrasound only |
| **Z.One PRO (Zonare)** | – | – | 10 | 1.5 | 11.25 | Linear | Yes | No | Ultrasound only |
| **POSTECH** | 10 | 680 – 950 | 5 | 4.5 | 7.5<br>3.5<br>2.5<br>6.5 | Linear,<br>Convex,<br>Phased,<br>Endocavity | Yes | Yes | Ultrasound only |

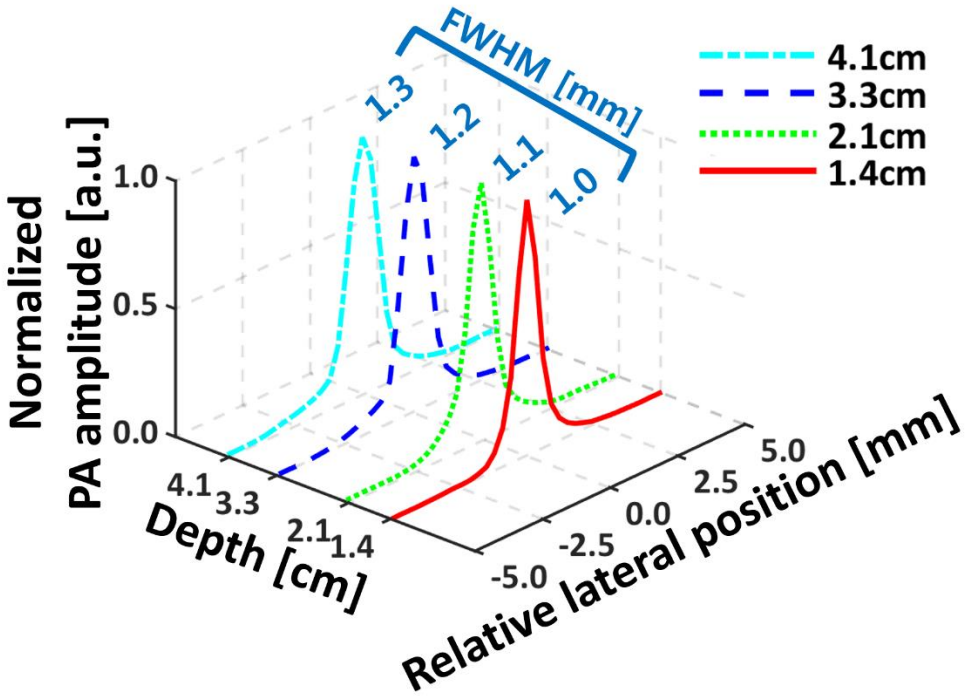


**Figure S1.** Quantified lateral resolution at various depths, measured by FWHM. PA, photoacoustic; and FWHM, full width at half maximum.

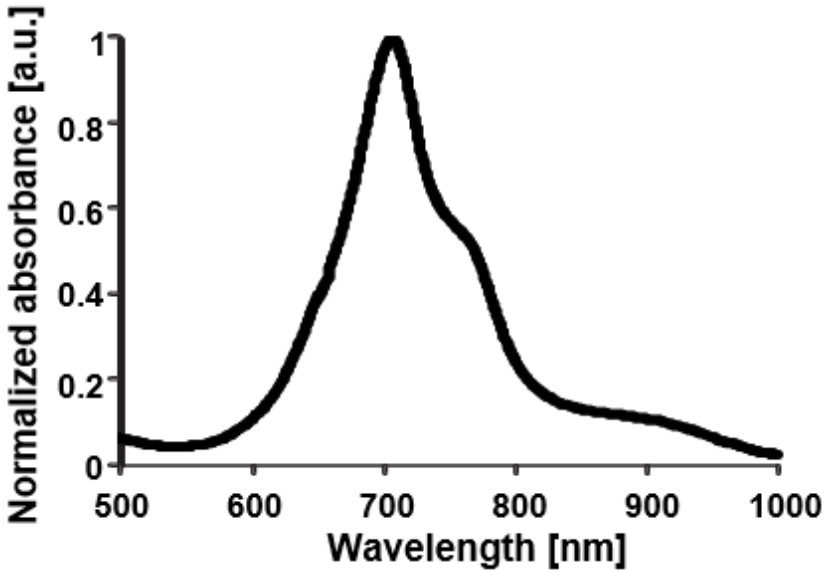


**Figure S2.** Normalized optical absorbance spectrum of the nanonap. The peak absorption wavelength is 707 nm.

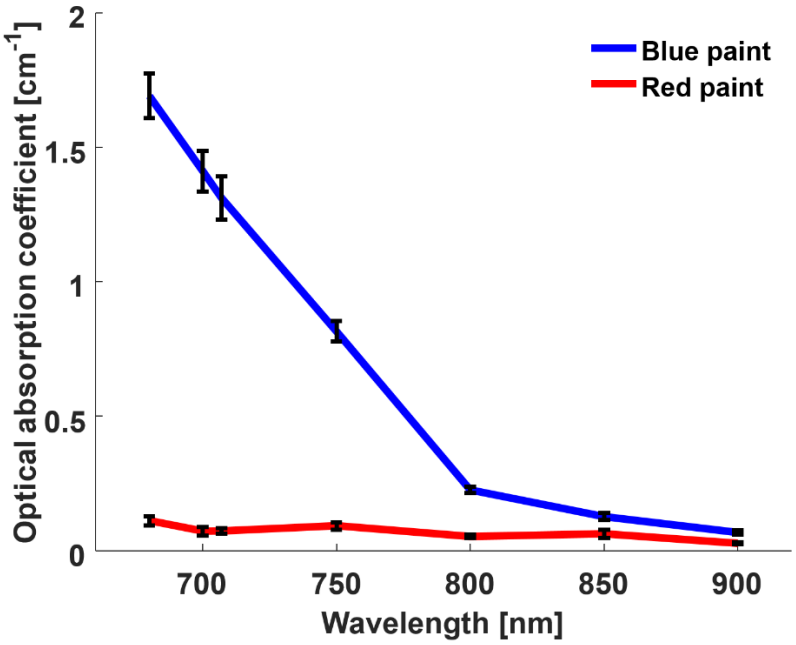


**Figure S3.** Optical absorption coefficients of blue and red paints.

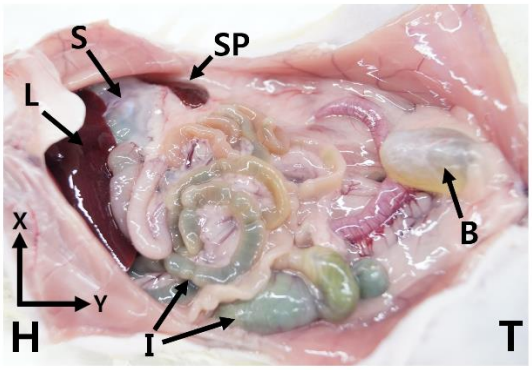


**Figure S4.** Photograph of the dissected rat acquired after *in vivo* imaging. The GI tract is dyed in green, which is the color of the nanonap. GI, gastrointestinal, H, head; T, tail; L, liver; S, stomach; I, intestine; and B, bladder.

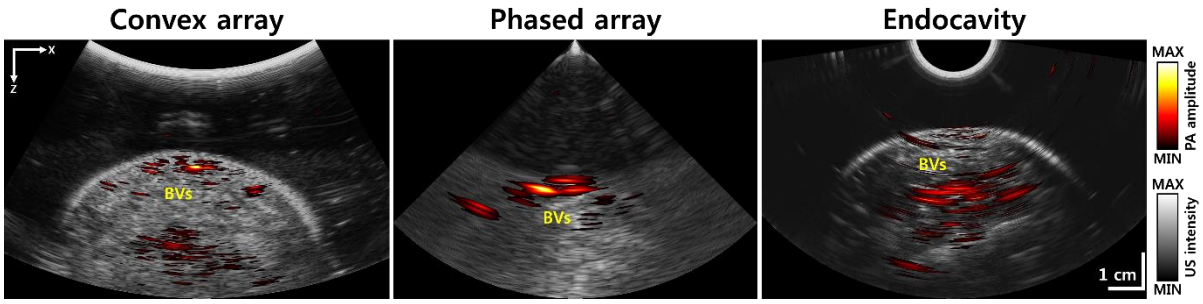


**Figure S5.** *In vivo* overlaid photoacoustic/ultrasound images of a human forearm acquired with convex array, phased array, and endocavity transducers. BV, blood vessel.

**Movie S1**. Movie form the volumetric images of the gastro-intestinal tract in a rat *in vivo*.