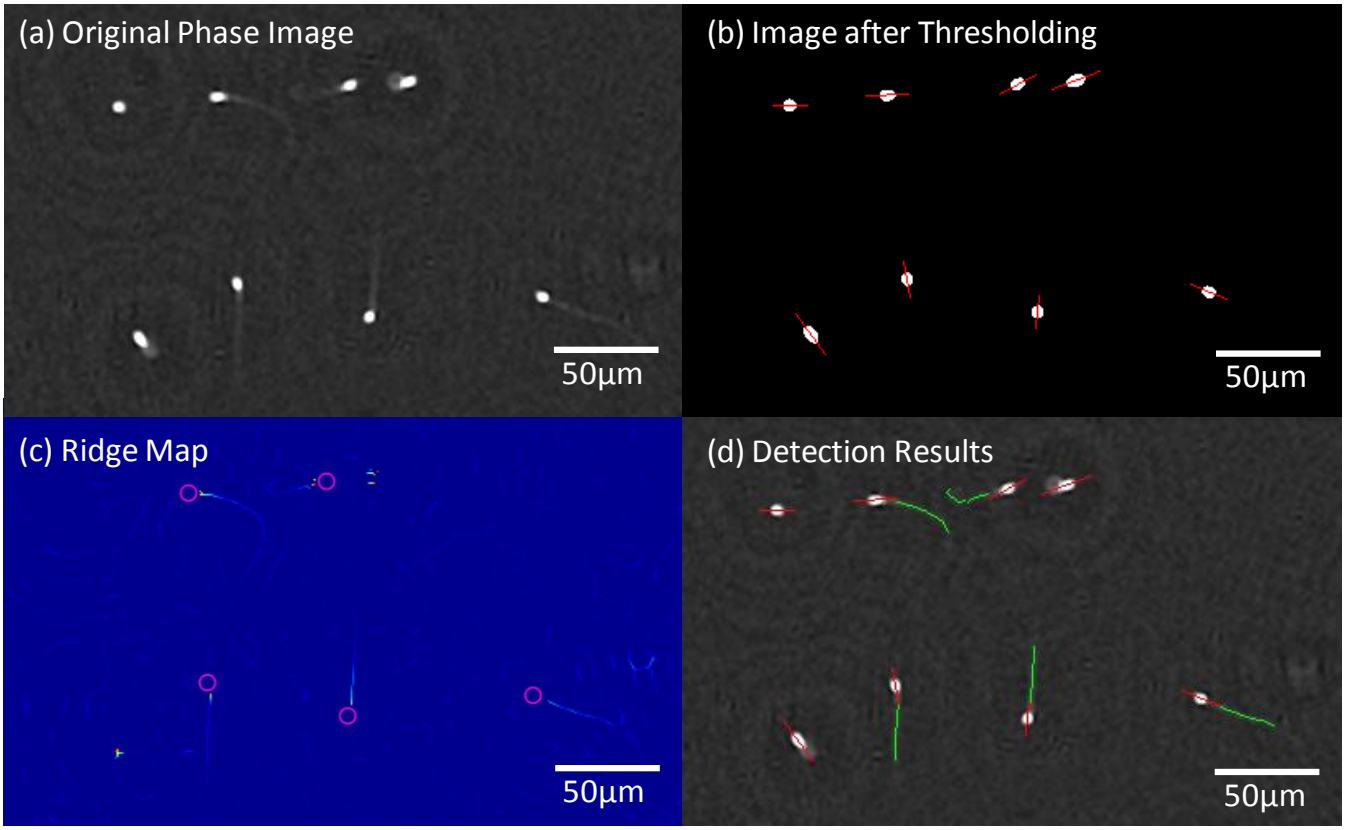
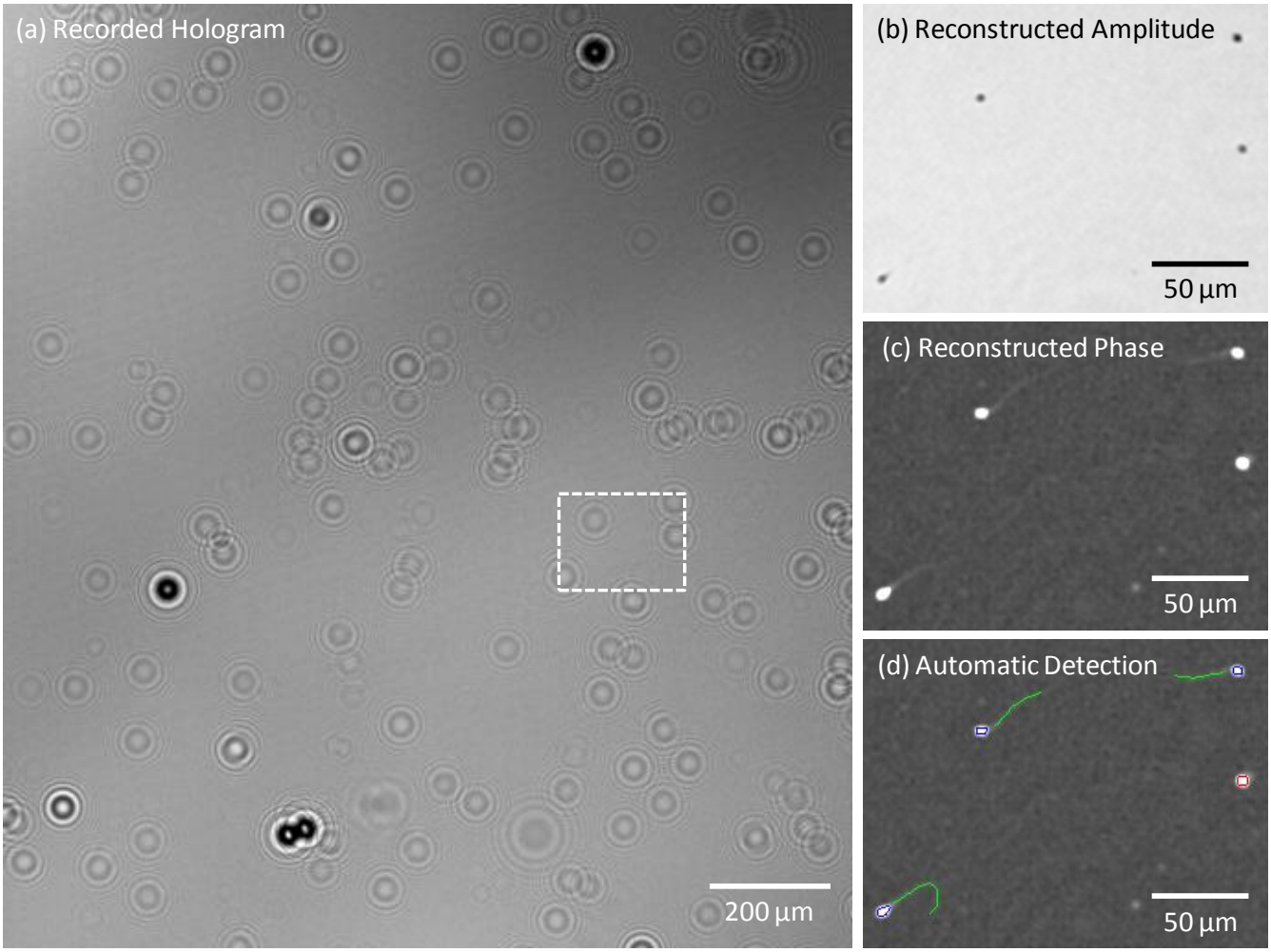
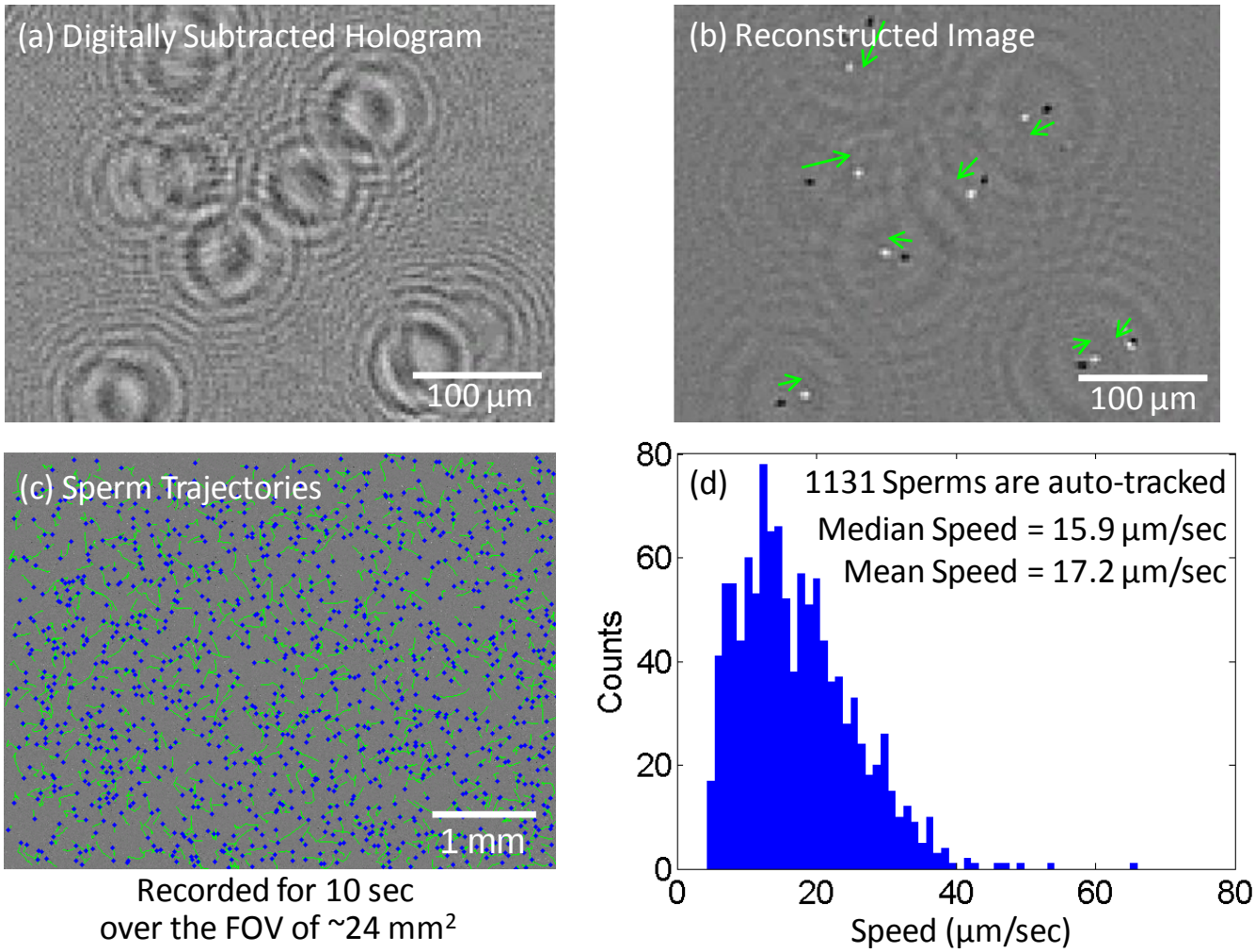
Supplementary Figures



Supplementary Figure 1. (a) The reconstructed phase image contains 8 sperms with different morphologies and orientations (same sample and field-of-view as in Fig. 2(d)). (b) A new image was digitally generated by thresholding the intensity of the image shown in (a) to highlight the position and the orientation of each sperm head. The red lines indicate the orientations (i.e., the major axis) of the elliptical sperm heads. (c) A ridge map of the original phase image shown in (a) was generated using a determinant-of-Hessian filter. Positions of the sperm heads in this image are marked with red circles. (d) By matching the orientation of each sperm head (red lines in (b)) with the orientation of the sperm tails (labeled by green curves in (d)), viable sperms within the sample were automatically identified. Refer to the Methods Section for details.



Supplementary Figure 2. (a) A digitally zoomed lensfree hologram of an immobilized semen sample (1.63 million sperms per mL) is shown. The darker holograms correspond to 20µm beads that were used as mechanical support (see the Methods section), whereas the rest of the lensfree holograms correspond to sperms. The region labeled by a white dashed box stands for the corresponding FOVs of (b), (c), and (d). (b) The amplitude image reconstructed from the raw hologram shown in (a) indicates the locations of the sperm heads over a zoomed FOV. (c) The phase image reconstructed from the raw hologram shown in (a) illustrates both the heads and the tails of the sperms over a zoomed FOV. (d) Similar to Supplementary Fig. 1, automatic characterization results are generated based on the phase image shown in (c). The heads of the sperms are marked by circles and the tails are labeled with green lines. Defective sperms with missing or unusually curved tails are not reported towards positive counts.



Supplementary Figure 3. Same analysis as in Figures 3 and 4 of the main text, this time for a more dense semen sample (2.36 million sperms per mL) is illustrated. The dynamic trajectories (green lines in (c)) of 1131 sperms within a field-of-view of ~24 mm^2 are automatically tracked over a time-span of 10 seconds. From these measurements, the speed histogram of these motile sperms is calculated as shown in (d).