Supplementary Materials for "Independent Component Analysis Involving Autocorrelated Sources with an Application to Functional Magnetic Resonance Imaging"

This document contains additional simulation results. Section S1 contains additional results under different SNRs (0.5,1,2,4) for Simulation Study III. In Section S2, we report the simulation results for the event related design task under four SNRs (0.5,1,2,4).

S1. Simulation Study III: Block Design

Figure 7 of the main document shows the average spatial maps of the first five simulation runs under SNR=1. In this section we report the average spatial maps of all 100 simulation runs under four different SNRs (SNR=0.5,1,2,4). Figure 1-4 show the average spatial maps at SNR=0.5,1,2,4, respectively.

Figure 1: Simulation Study III: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=0.5. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.

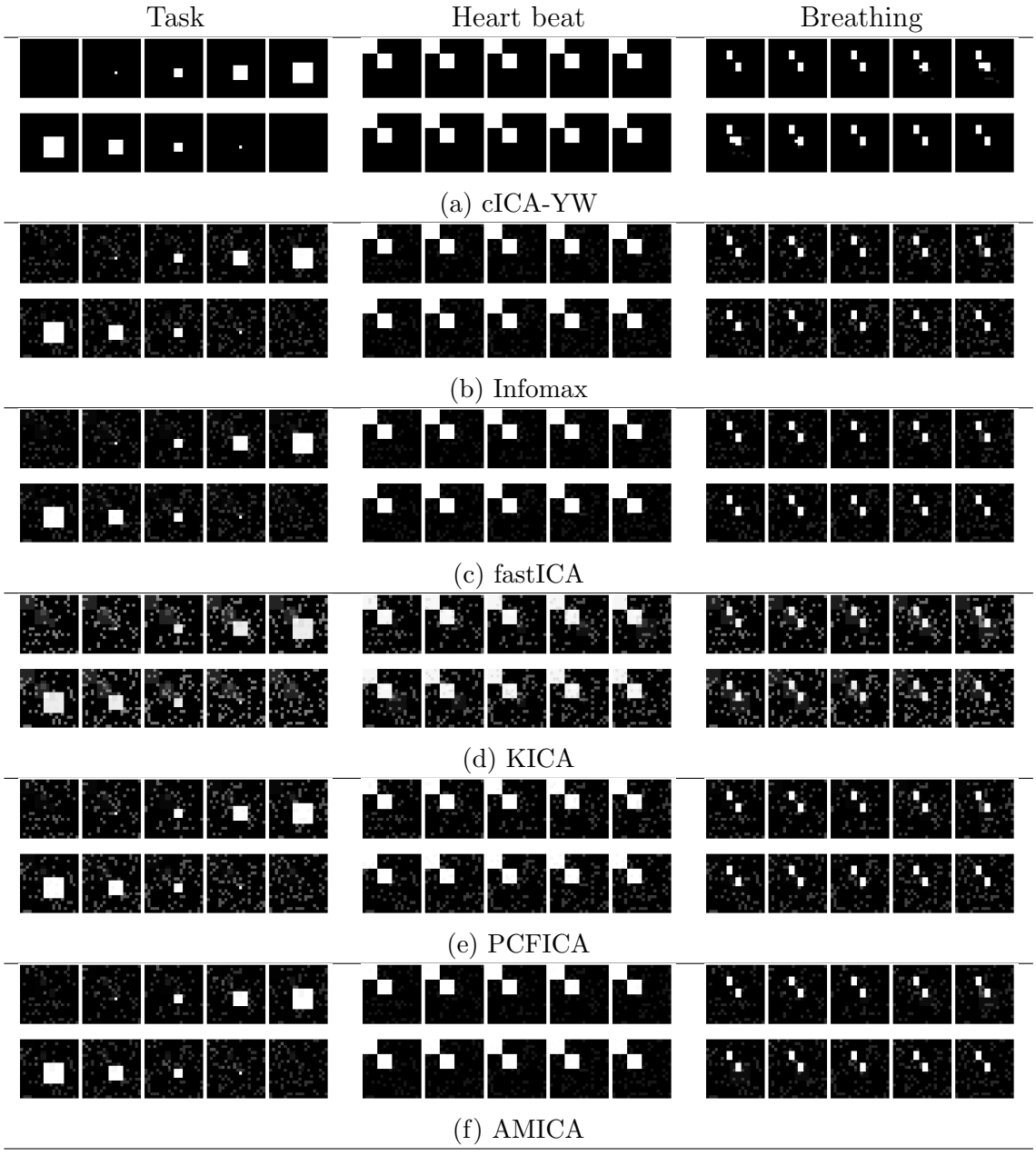


Figure 2: Simulation Study III: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=1. 100 simulation runs are performed. The relative frequency of each voxel detected as activated our of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.

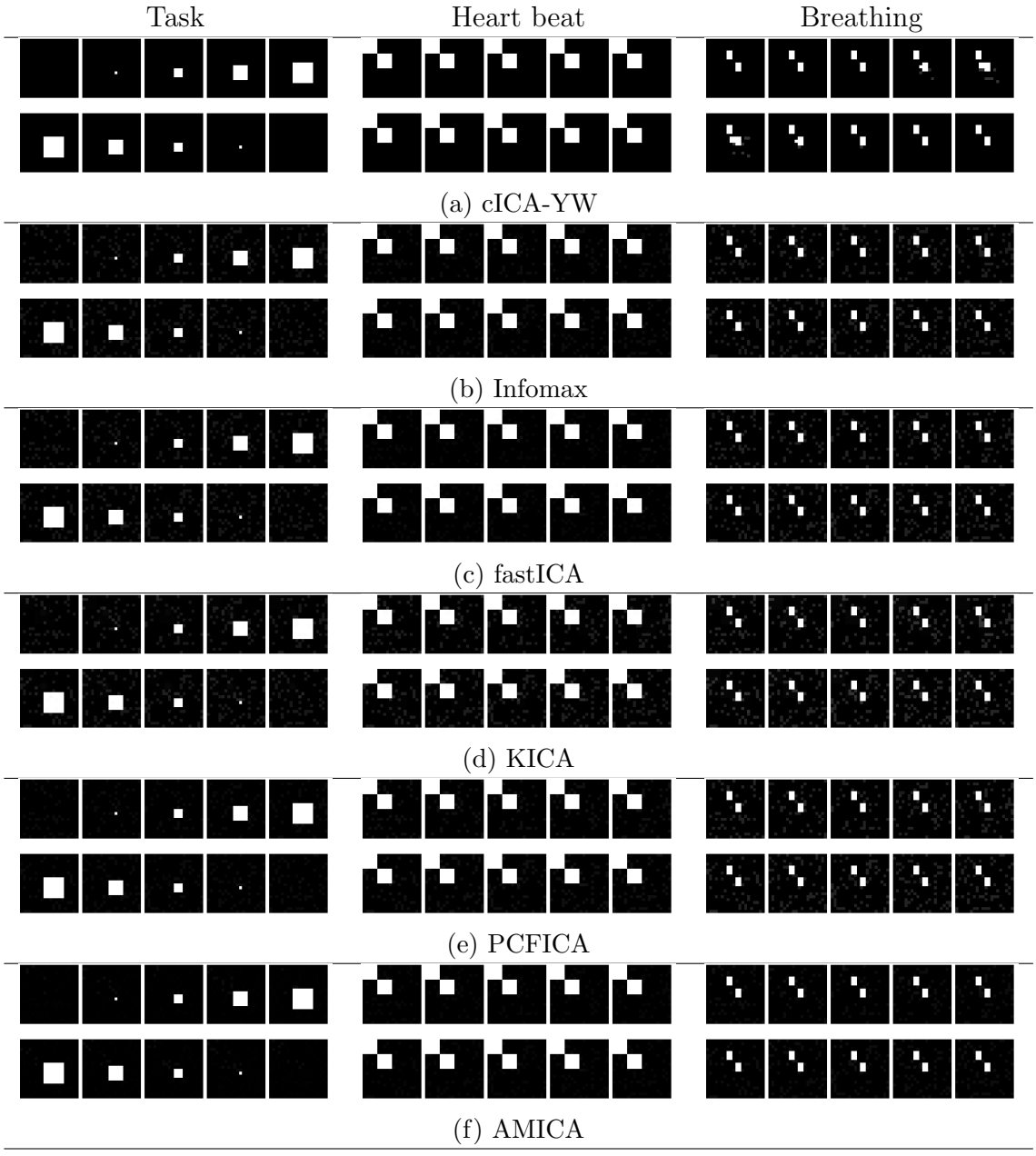


Figure 3: Simulation Study III: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=2. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation better than the other ICA methods.

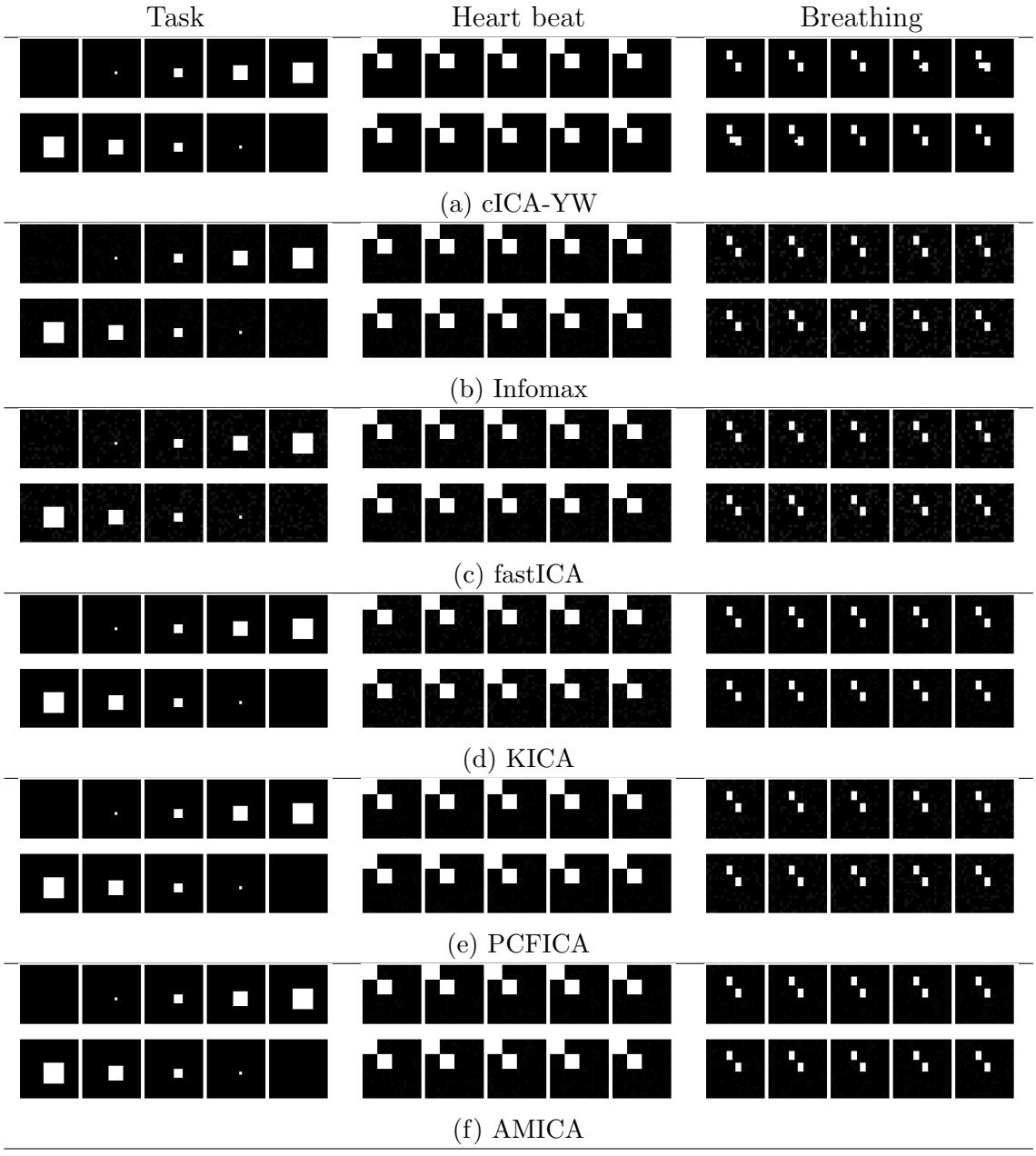


Figure 4: Simulation Study III: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=4. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. Most methods except Infomax perform well.

S2. Simulation IV: Event-related Design

As discussed at the end of Section 3.3.2 (page 26) of the main document, we conduct a simulation study for event-related design which is similar to Simulation III. The only difference from Simulation III is the random event-related task function which was generated with mean ISI = 4.5sec. For the added noise to the task function, we used white noise from uniform distribution.

Figure 5 depicts one simulated data at SNR= 1. The average false discovery rates and summary spatial maps at different SNRs (0.5,1,2,4) are displayed in Figures 6-10 respectively. For event-related tasks, cICA-YW also outperforms other ICA methods.

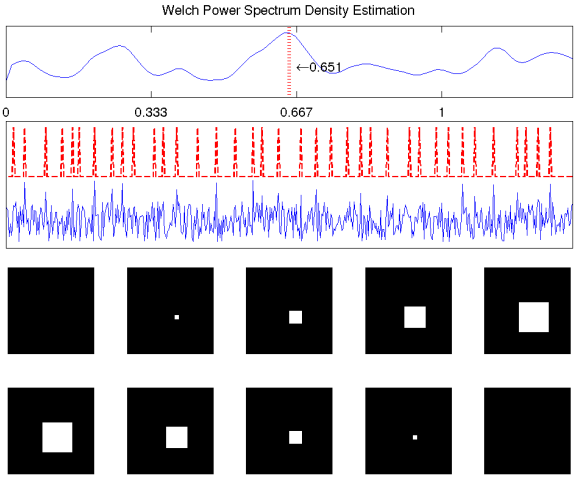
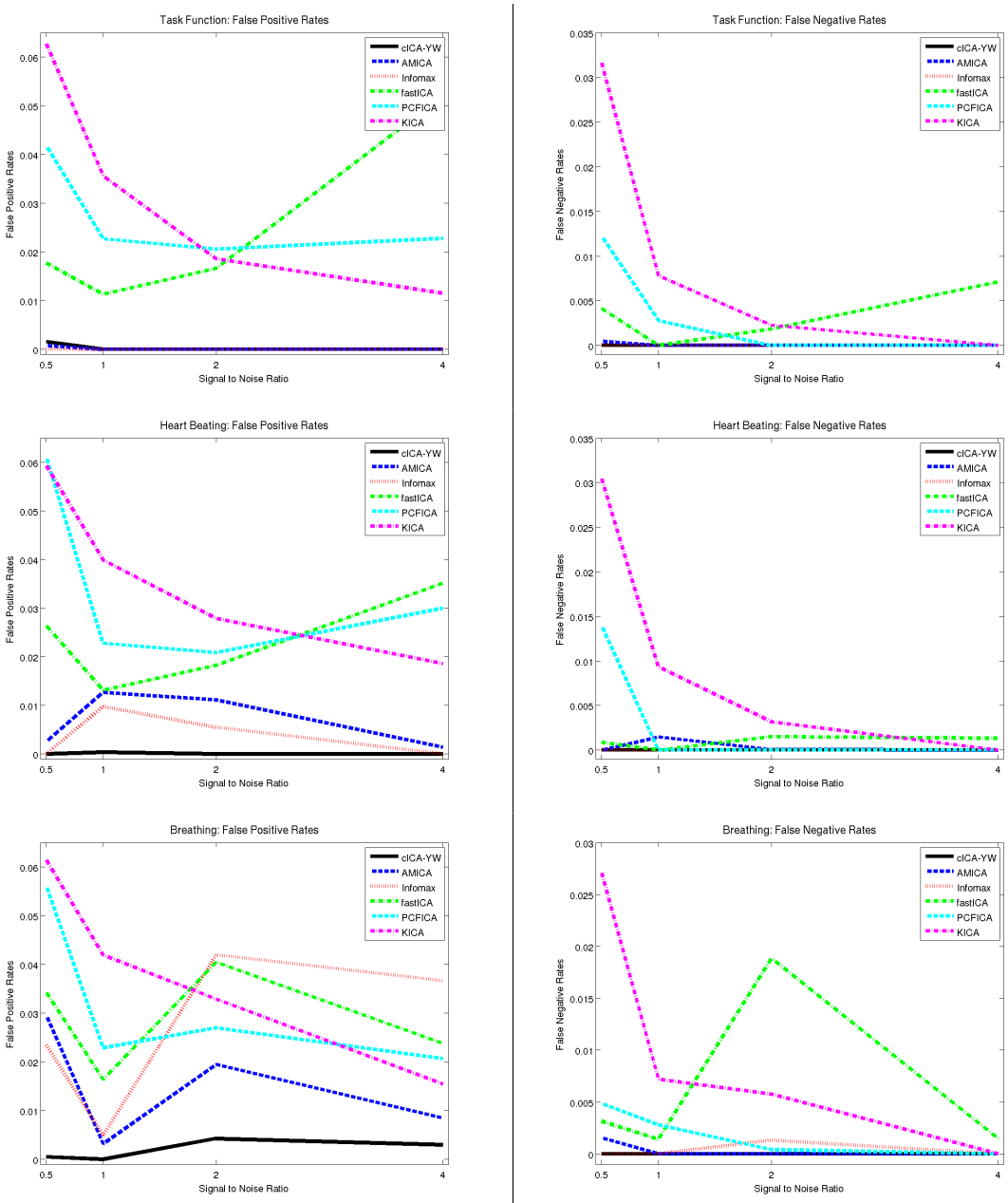


Figure 5: Simulation Study IV: The True Independent Temporal Components, Spectral Densities and Spatial Maps. The event-related design task function is displayed with the corresponding spatial maps. The activated voxels are colored as white and non-activated voxels are colored as black. Other three components (heart beat, breathing, and noise) are same as those in Simulation III.



(a) False Positive Rates (b) False Negative Rates

Figure 6: Simulation Study IV: Comparisons of False Positive and False Negative Rates. Four different SNRs are considered. False positive and false negative rates are averaged over 100 simulation runs and displayed at left and right columns respectively. The cICA performs uniformly better than the other five methods.

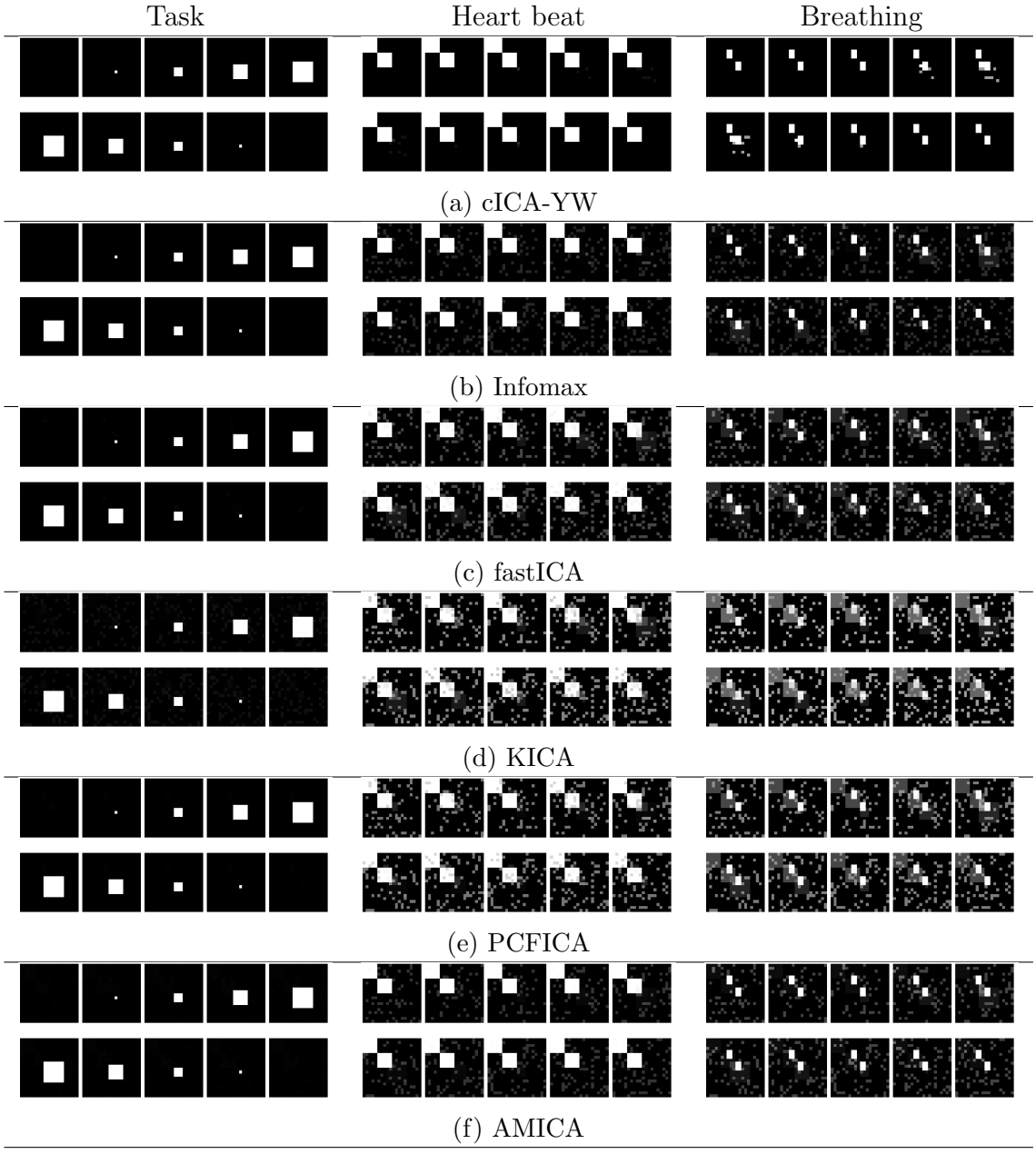


Figure 7: Simulation Study IV: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=0.5. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.

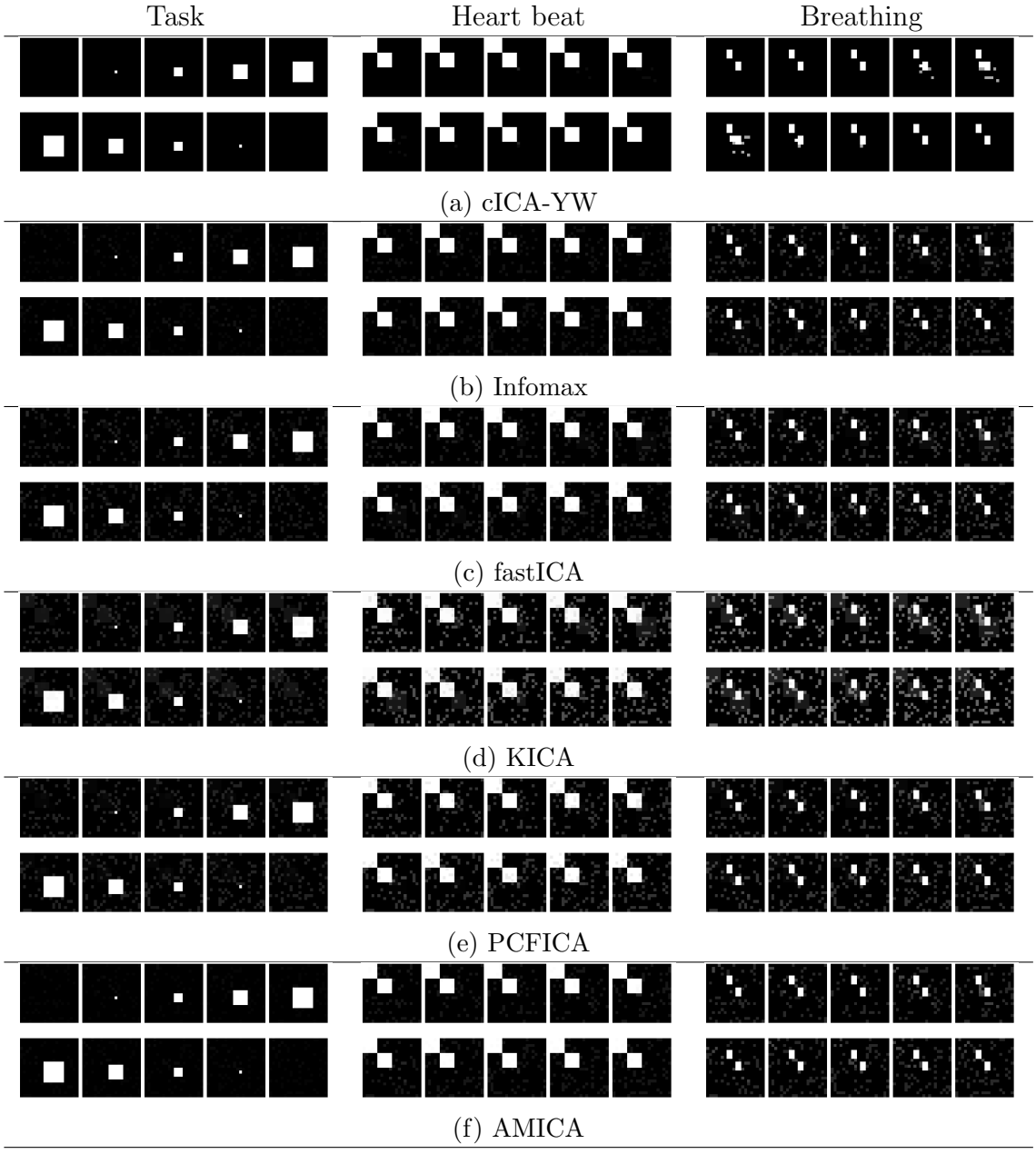


Figure 8: Simulation Study IV: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=1. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.

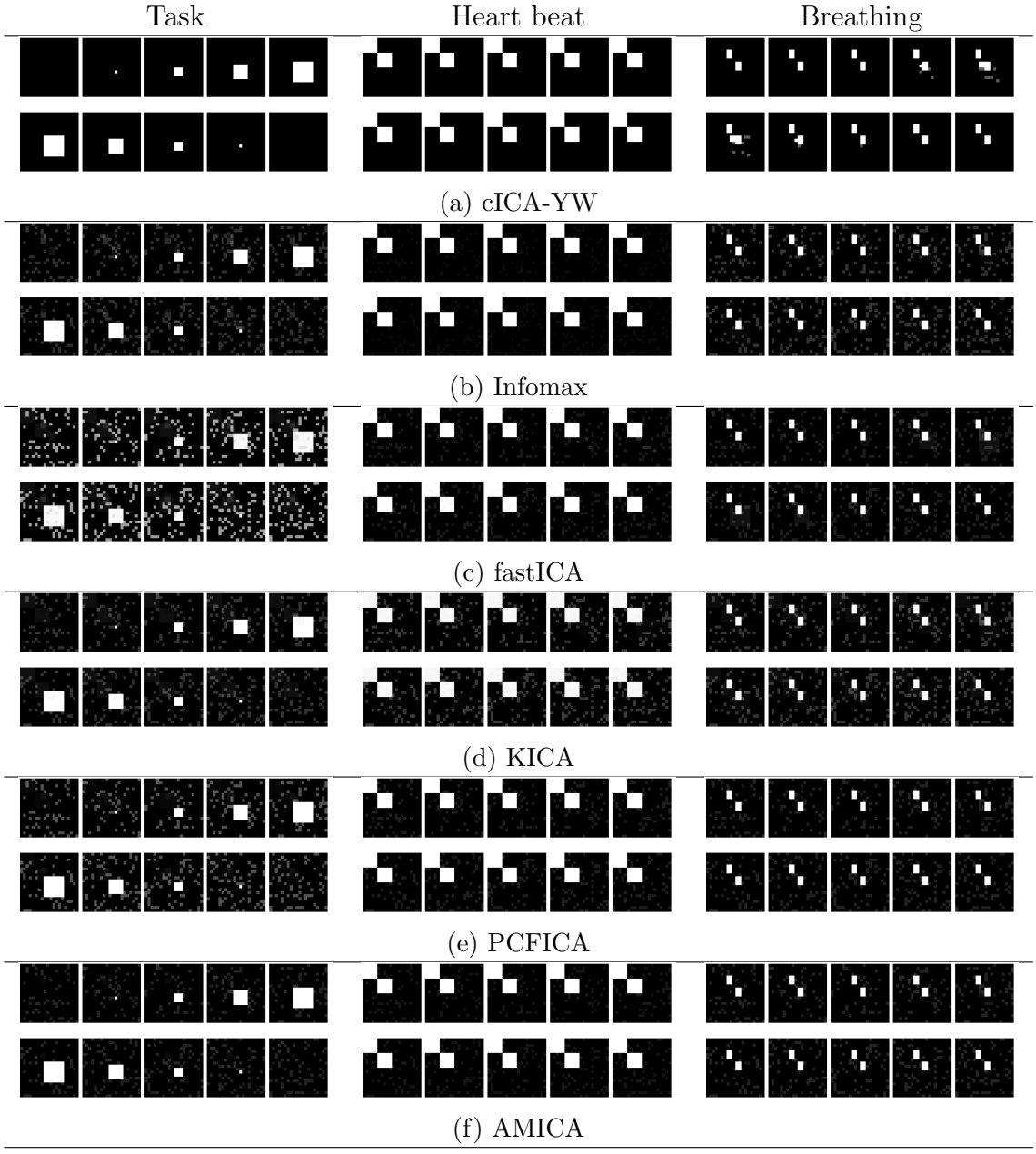


Figure 9: Simulation Study IV: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=2. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.

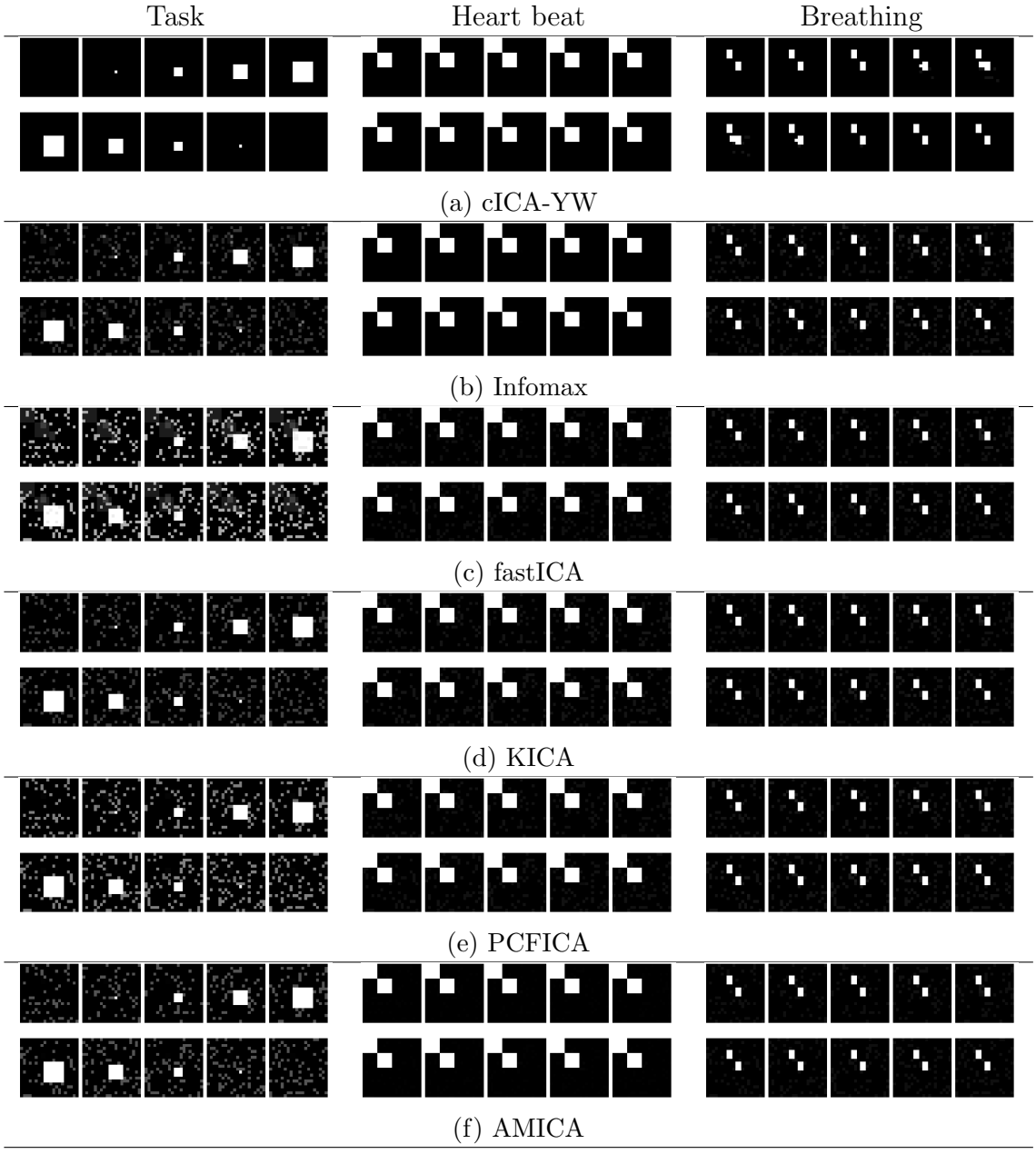


Figure 10: Simulation Study IV: Spatial Maps Detected by cICA-YW, Infomax, fastICA, KICA, PCFICA, and AMICA under SNR=4. 100 simulation runs are performed. The relative frequency of each voxel detected as activated out of 100 simulation runs is colored using white (1) to black (0) with gray scale. The cICA-YW detects the spatial activation much better than the other ICA methods.