

A Signal-Centric Perspective on the Evolution of Symbolic Communication (Supplementary Material)

QUINTINO FRANCESCO LOTITO, University of Trento

LEONARDO LUCIO CUSTODE, University of Trento

GIOVANNI IACCA, University of Trento

CONSTELLATIONS FOR THE SIGNALING SYSTEMS EVOLVED AT VARIOUS LEVELS OF NOISE

In Figures 2-8 we show the constellations of signals of the best signaling systems evolved in each of the 20 evolutionary runs in a subset of the experiments with noise reported in Section 5.3 of the main text, namely: regression and classification settings, with unlimited amplitude, 3 trials per concept, and Gaussian noise $\mathcal{N} \sim (0, \sigma^2)$, with $\sigma = 0.1$, $\sigma = 0.2$, $\sigma = 0.5$ and $\sigma = 1$.

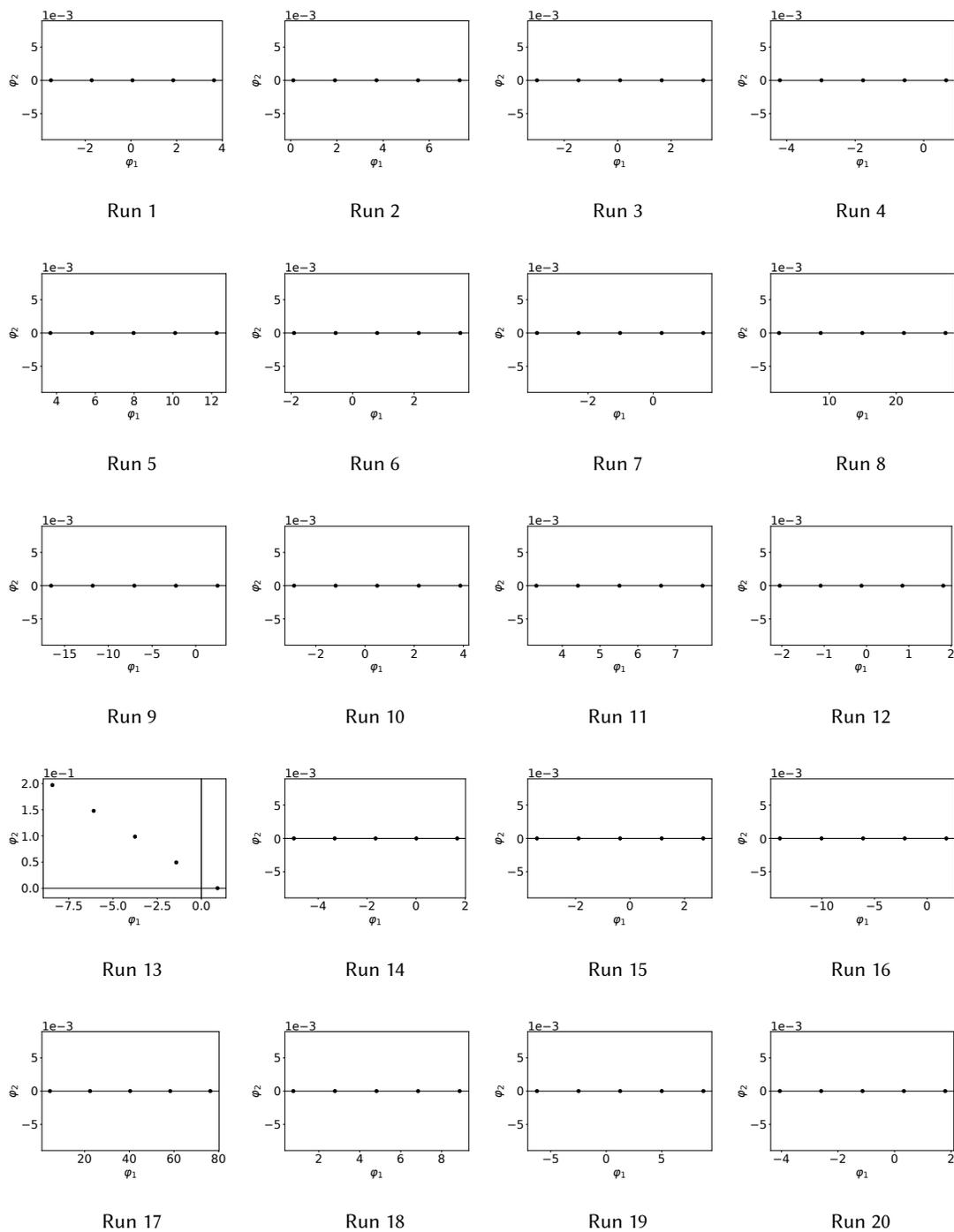


Fig. 1. Constellation of signals of the best signaling systems evolved in the regression setting, unlimited amplitude, 3 trials, $\sigma = 0.1$.

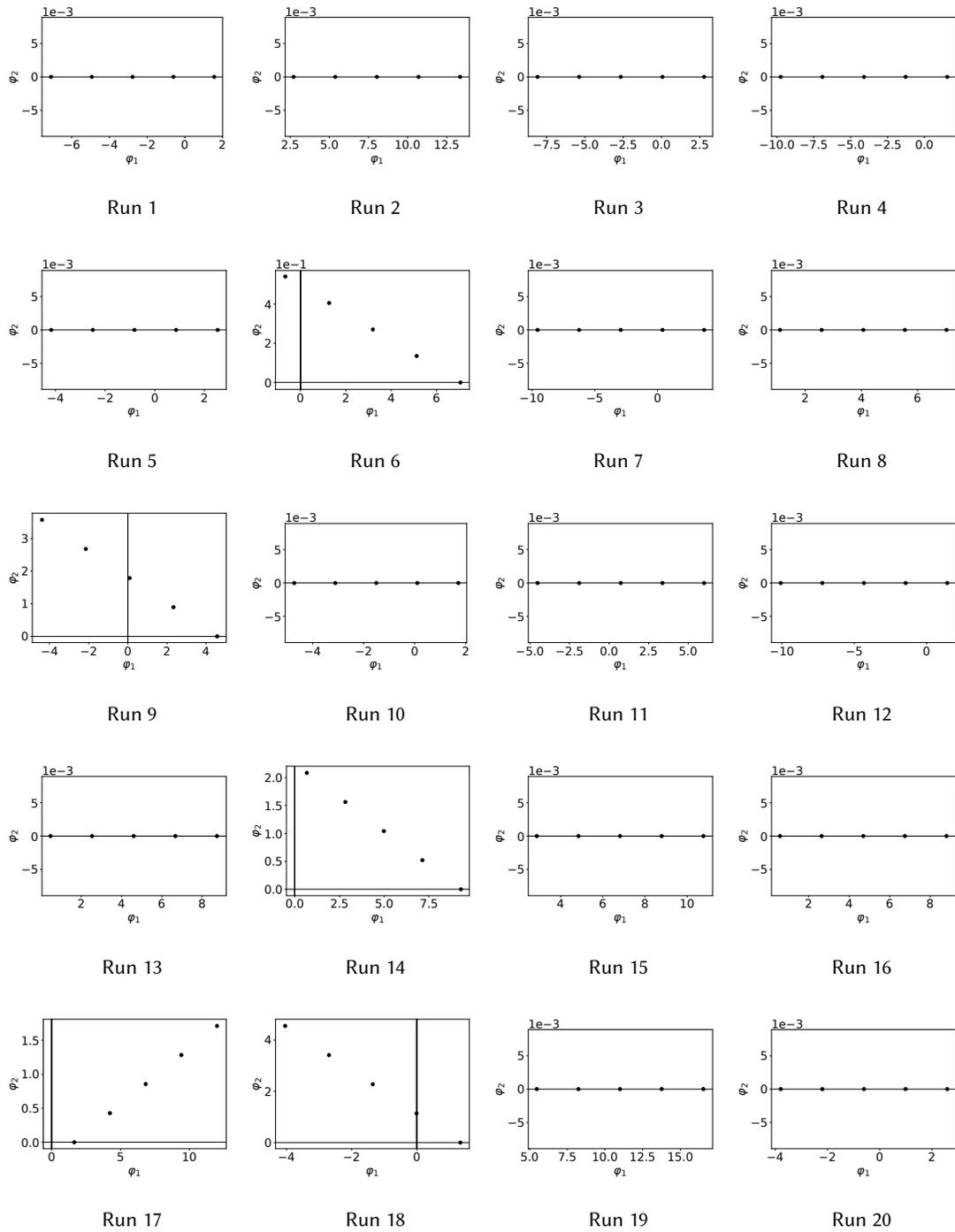


Fig. 2. Constellation of signals of the best signaling systems evolved in the regression setting, unlimited amplitude, 3 trials, $\sigma = 0.2$.

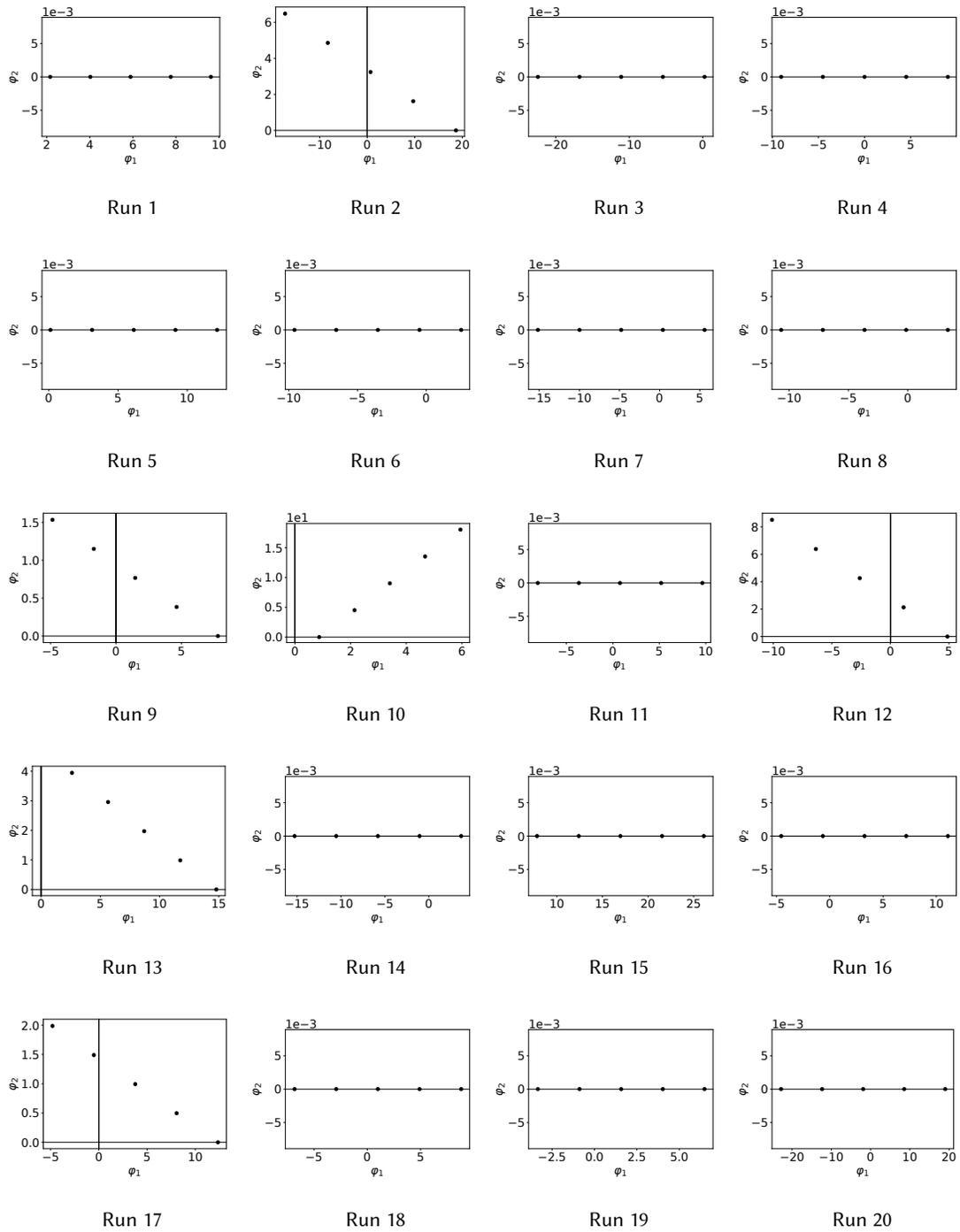


Fig. 3. Constellation of signals of the best signaling systems evolved in the regression setting, unlimited amplitude, 3 trials, $\sigma = 0.5$.

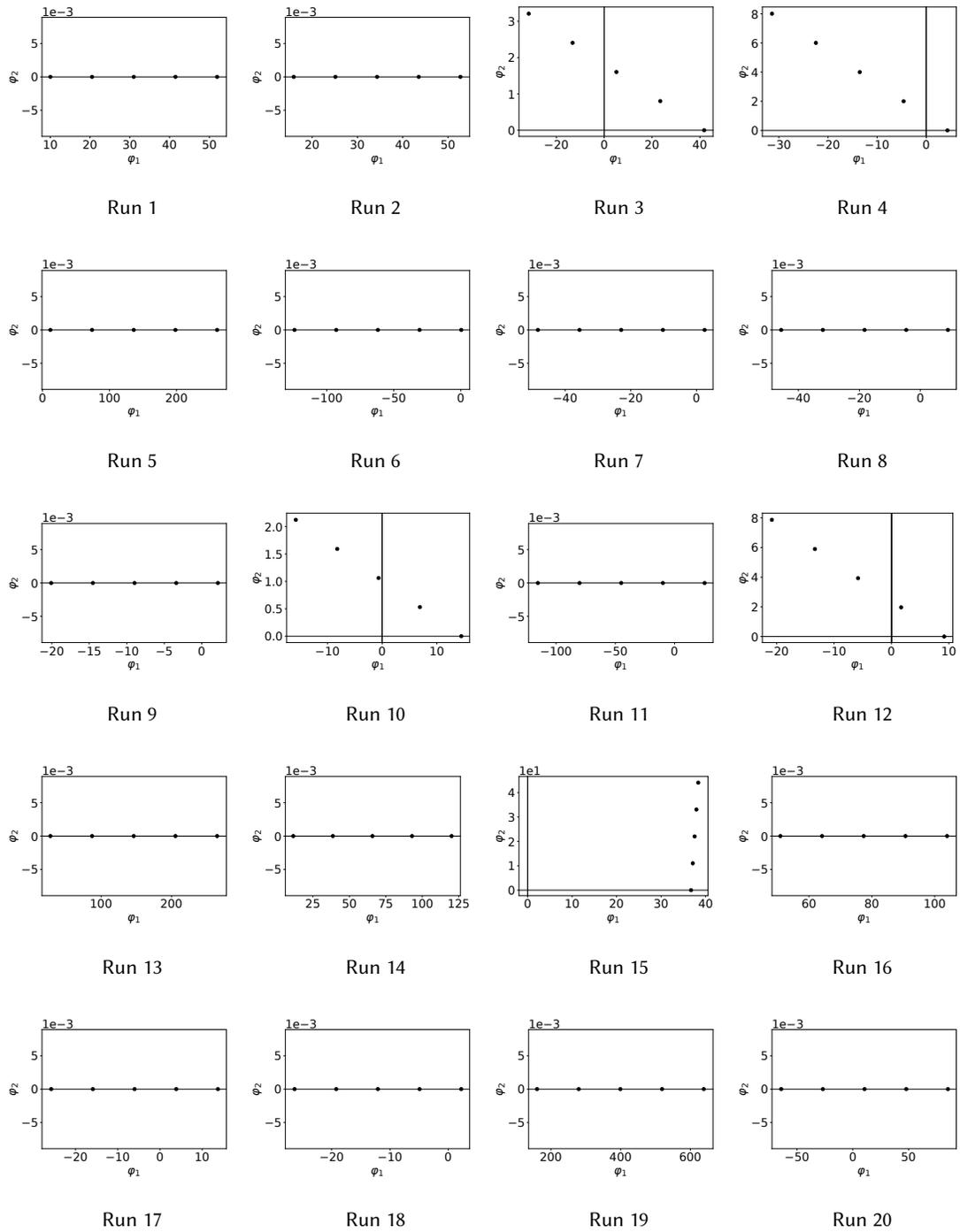


Fig. 4. Constellation of signals of the best signaling systems evolved in the regression setting, unlimited amplitude, 3 trials, $\sigma = 1$.

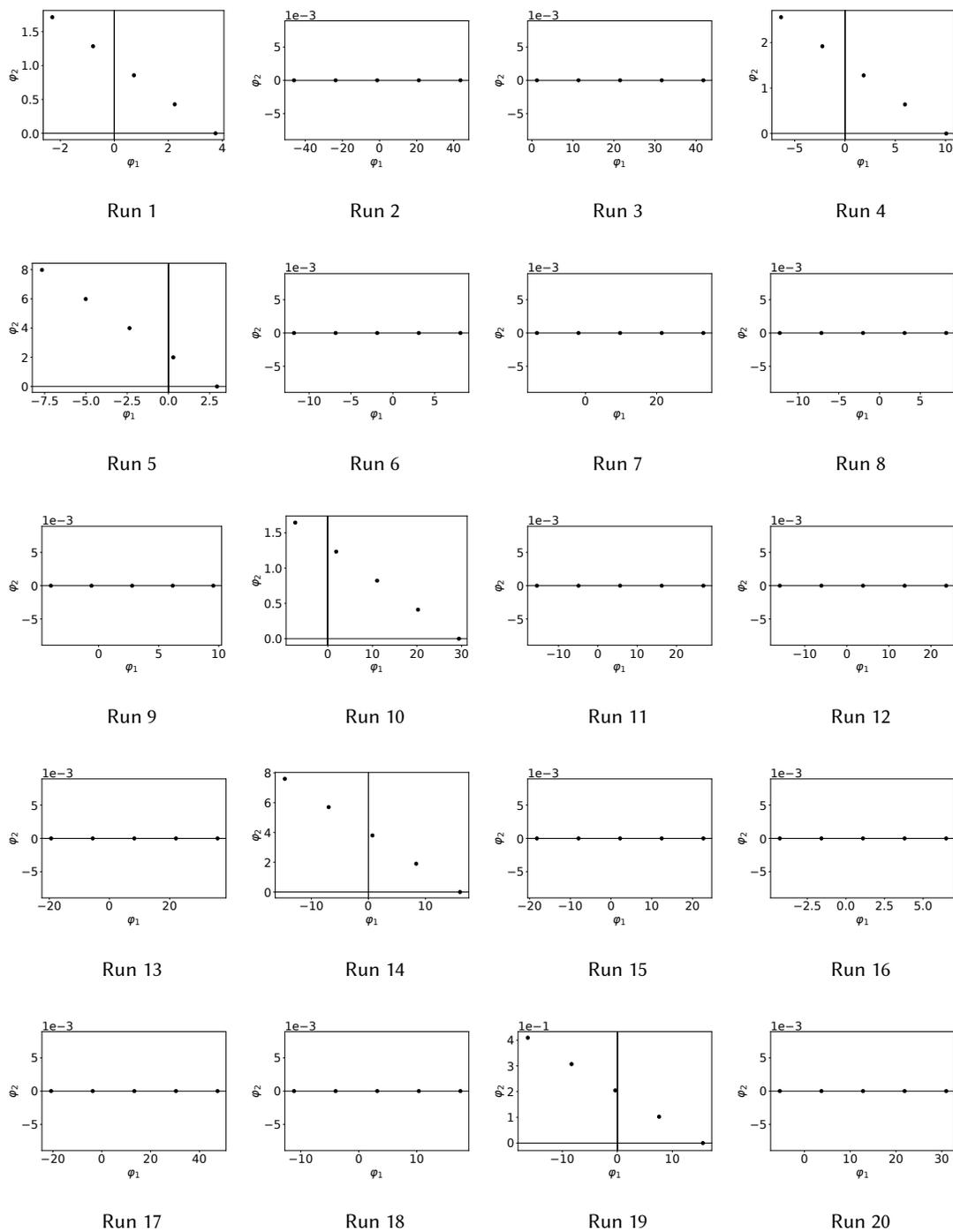


Fig. 5. Constellation of signals of the best signaling systems evolved in the classification setting, unlimited amplitude, 3 trials, $\sigma = 0.1$.

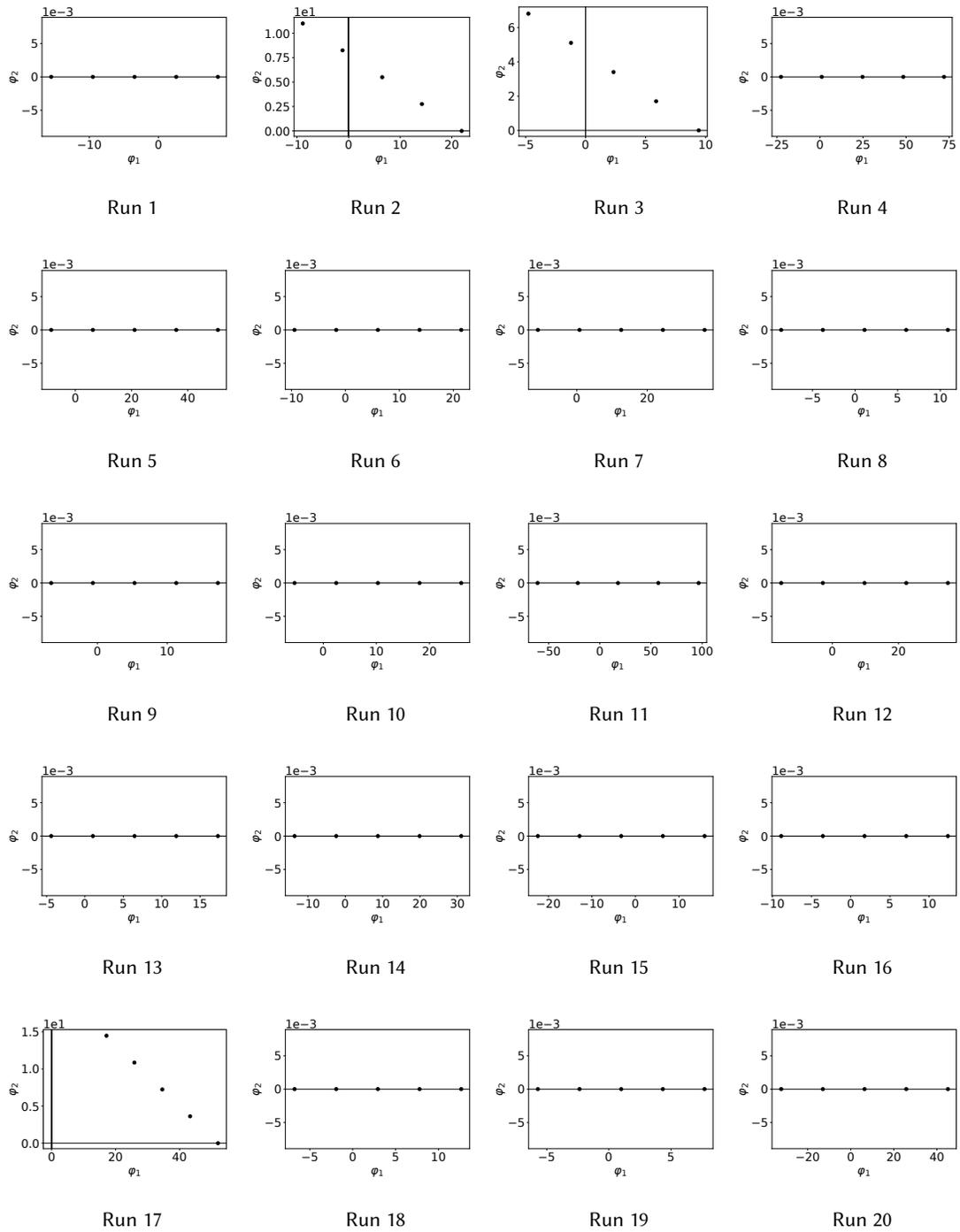


Fig. 6. Constellation of signals of the best signaling systems evolved in the classification setting, unlimited amplitude, 3 trials, $\sigma = 0.2$.

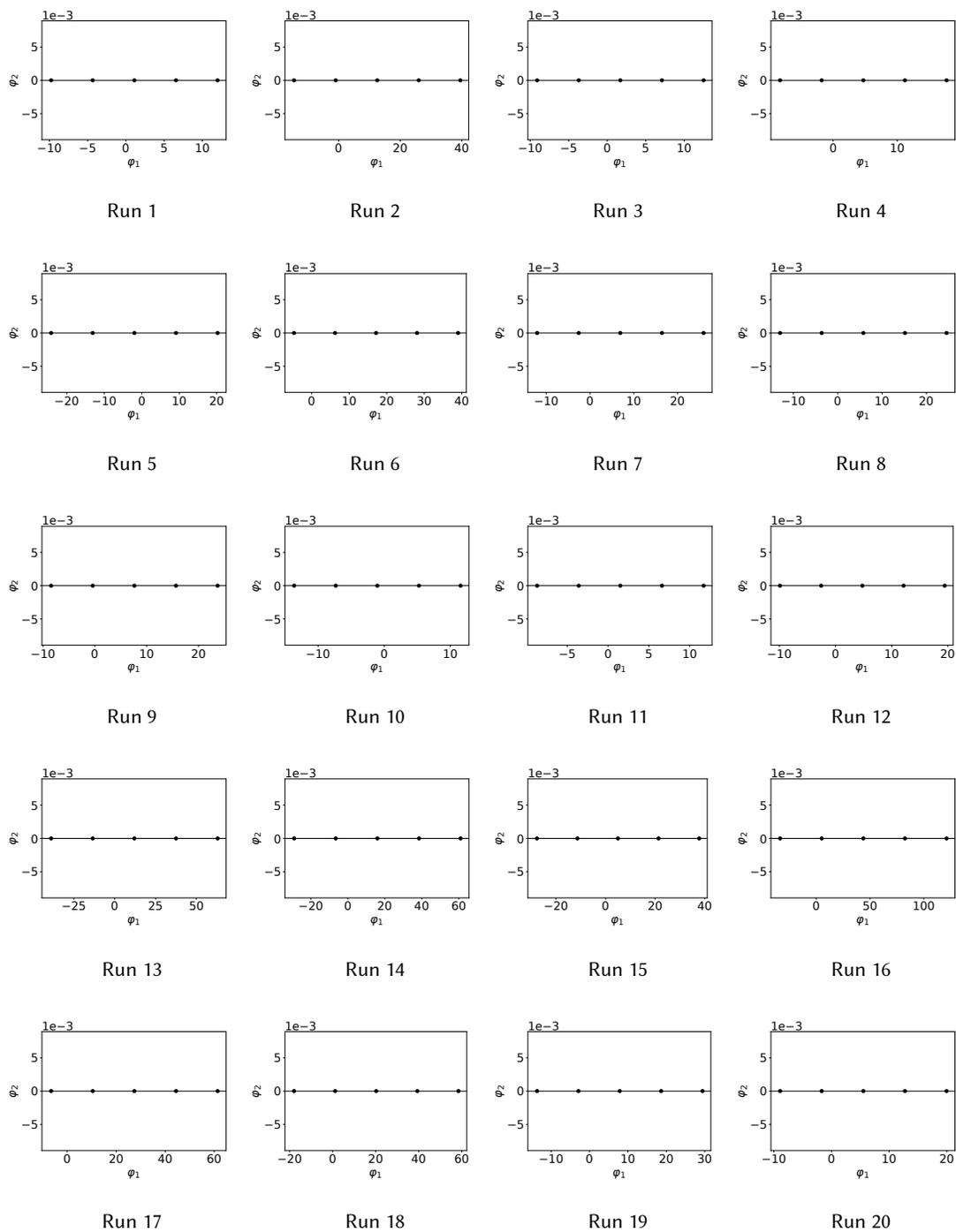


Fig. 7. Constellation of signals of the best signaling systems evolved in the classification setting, unlimited amplitude, 3 trials, $\sigma = 0.5$.

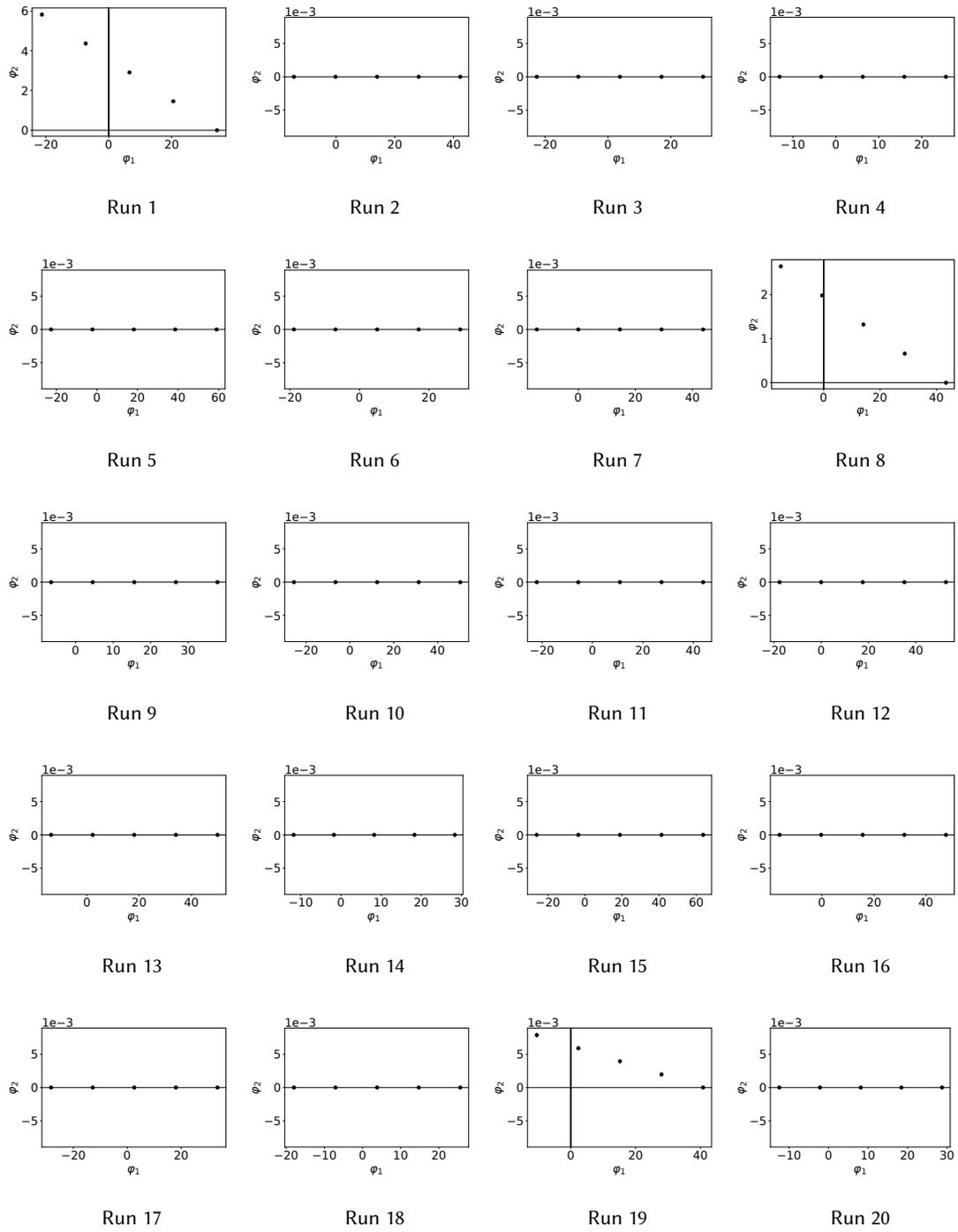
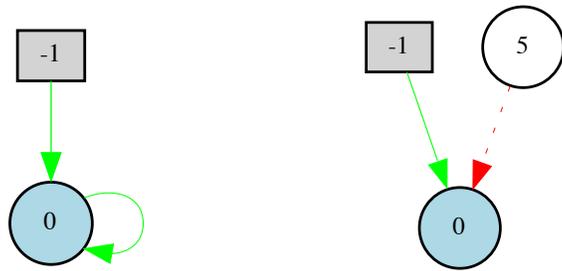


Fig. 8. Constellation of signals of the best signaling systems evolved in the classification setting, unlimited amplitude, 3 trials, $\sigma = 1$.

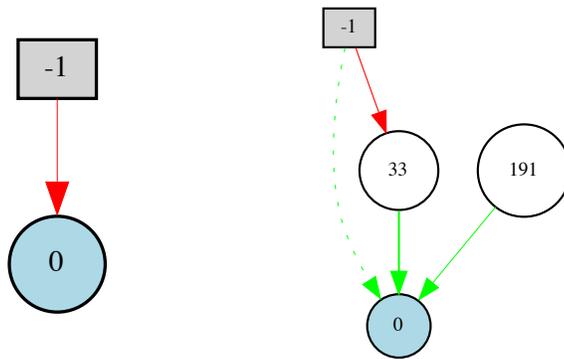
EXAMPLES OF EVOLVED SENDER/RECEIVER NETWORKS

In Figures 9-10 we show some examples of the networks evolved in the regression and classification settings, respectively, with both unlimited and limited amplitude, 3 trials per concept, and Gaussian noise $\mathcal{N} \sim (0, \sigma^2)$, with $\sigma = 0.1$.



(a) Regression, unlimited: sender

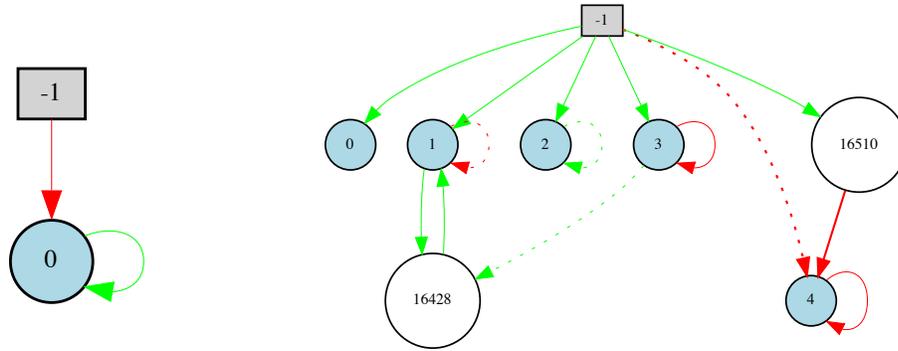
(b) Regression, unlimited: receiver



(c) Regression, limited: sender

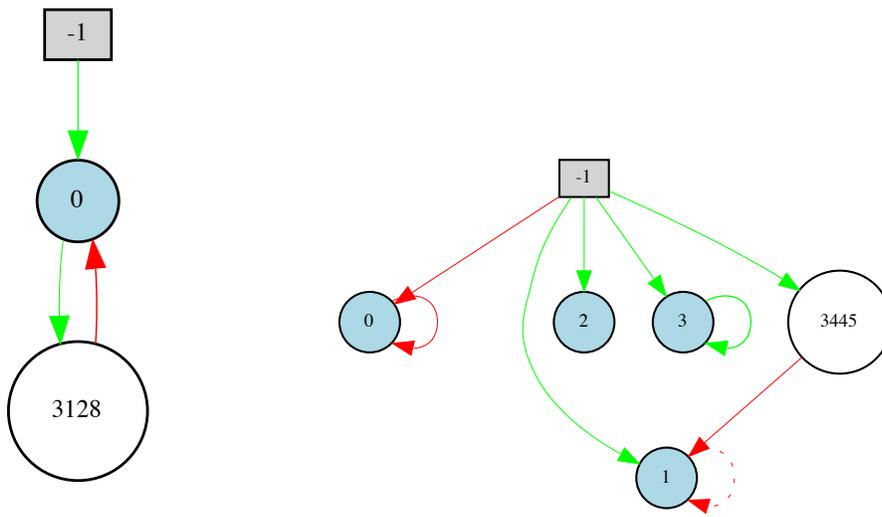
(d) Regression, limited: receiver

Fig. 9. Examples of the networks evolved in the regression settings, 3 trials, $\sigma = 0.1$.



(a) Classification, unlimited: sender

(b) Classification, unlimited: receiver



(c) Classification, limited: sender

(d) Classification, limited: receiver

Fig. 10. Examples of the networks evolved in the classification settings, 3 trials, $\sigma = 0.1$.