Information flow principles for plasticity in foraging robot swarms (online supplementary material)

Lenka Pitonakova[1,3], Richard Crowder [1] and Seth Bullock[2]

[1]Institute for Complex Systems Simulation and Department of Electronics and Computer Science, United Kingdom

[2]School of Computer Science, University of Bristol, Bristol, United Kingdom

[3]contact@lenkaspace.net

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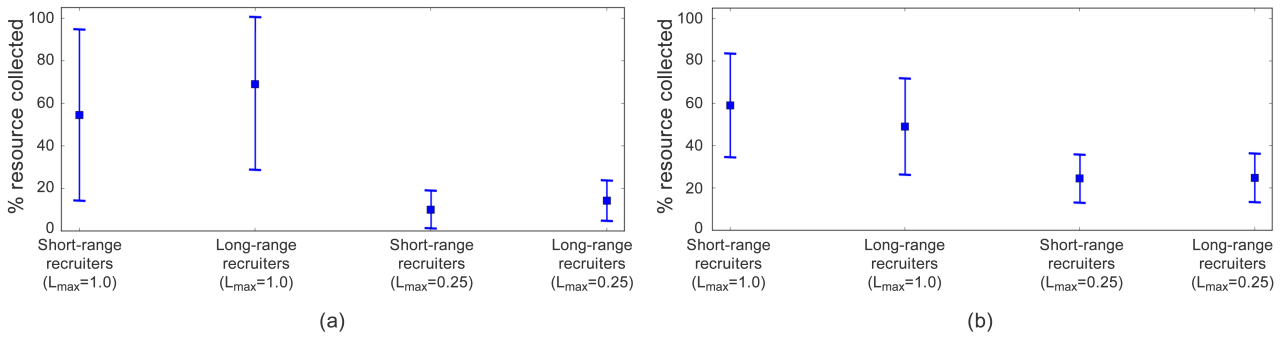


Figure S1: Foraging performance of 25-robot swarms in the (a) Heap1 and (b) Scatter25 scenarios using various controllers and different amount of resource volume loaded per foraging trip (L_{max}). Each point represents mean percentage of available resource that was collected in a given scenario, collated over 50 one-hour-long runs for each of the deposit distances in the set $D = \{7, 9, 11, 13\}$ m. The whiskers represent 95% confidence intervals.

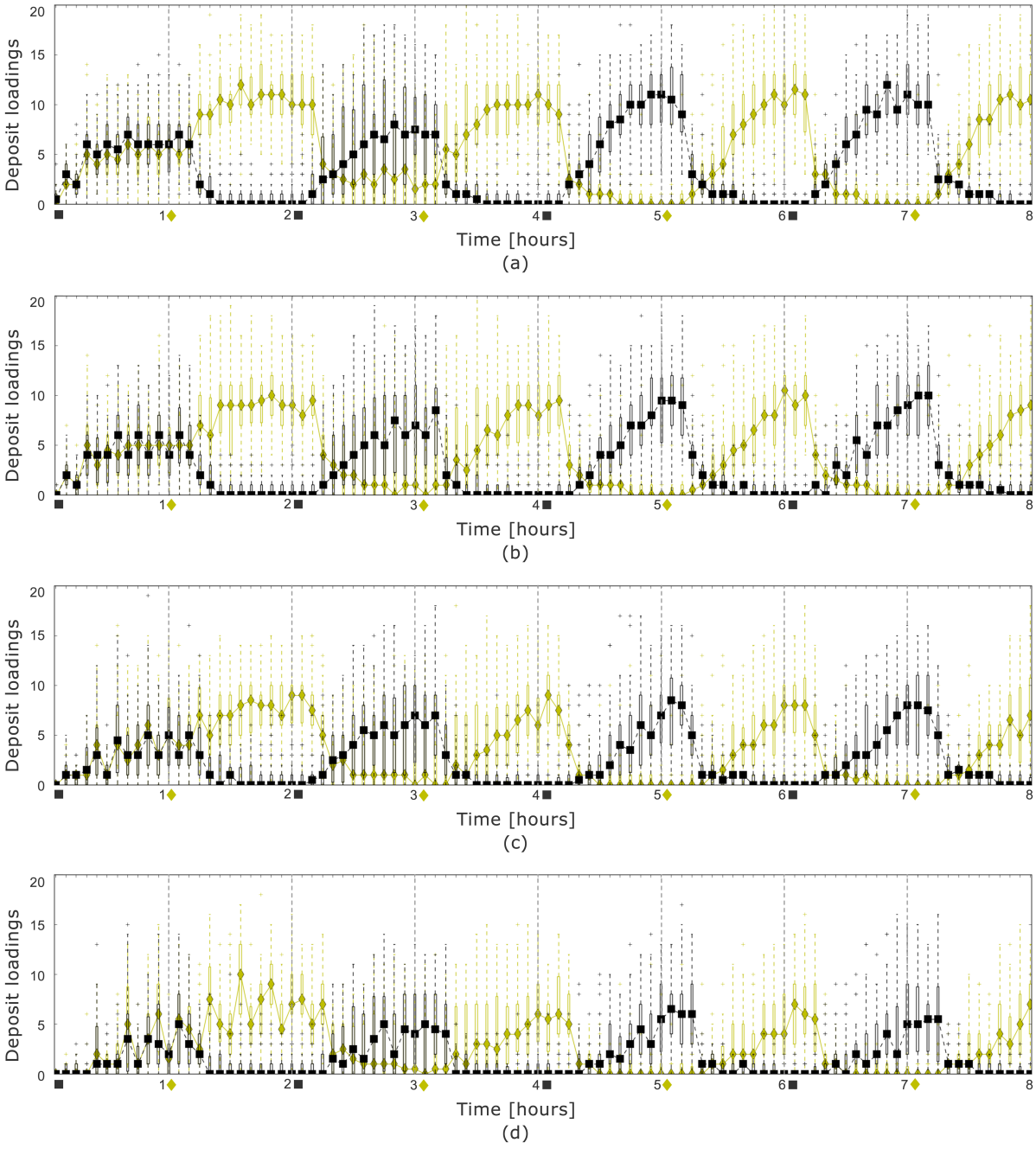


Figure S2: Median number of loadings from two deposits (square and diamond symbols) during the first eight hours of simulation using 25 short-range checkers in the Heap2B scenario with $T_Q = 1$ h and (a) $D = 7$ m, (b) $D = 9$ m, (c) $D = 11$ m, (d) $D = 13$ m. Deposit qualities were exchanged every hour during the experiment. The symbol of the deposit with higher quality is shown along the time axis at the beginning of each hour. Each data point represents a median value for a particular time interval and is based on a set of results collected from 50 independent runs. A data point is surrounded by a box, representing the inter-quartile range or "middle fifty" of the result set, and whiskers representing the "middle 97", with outliers outside this range shown as plus signs.

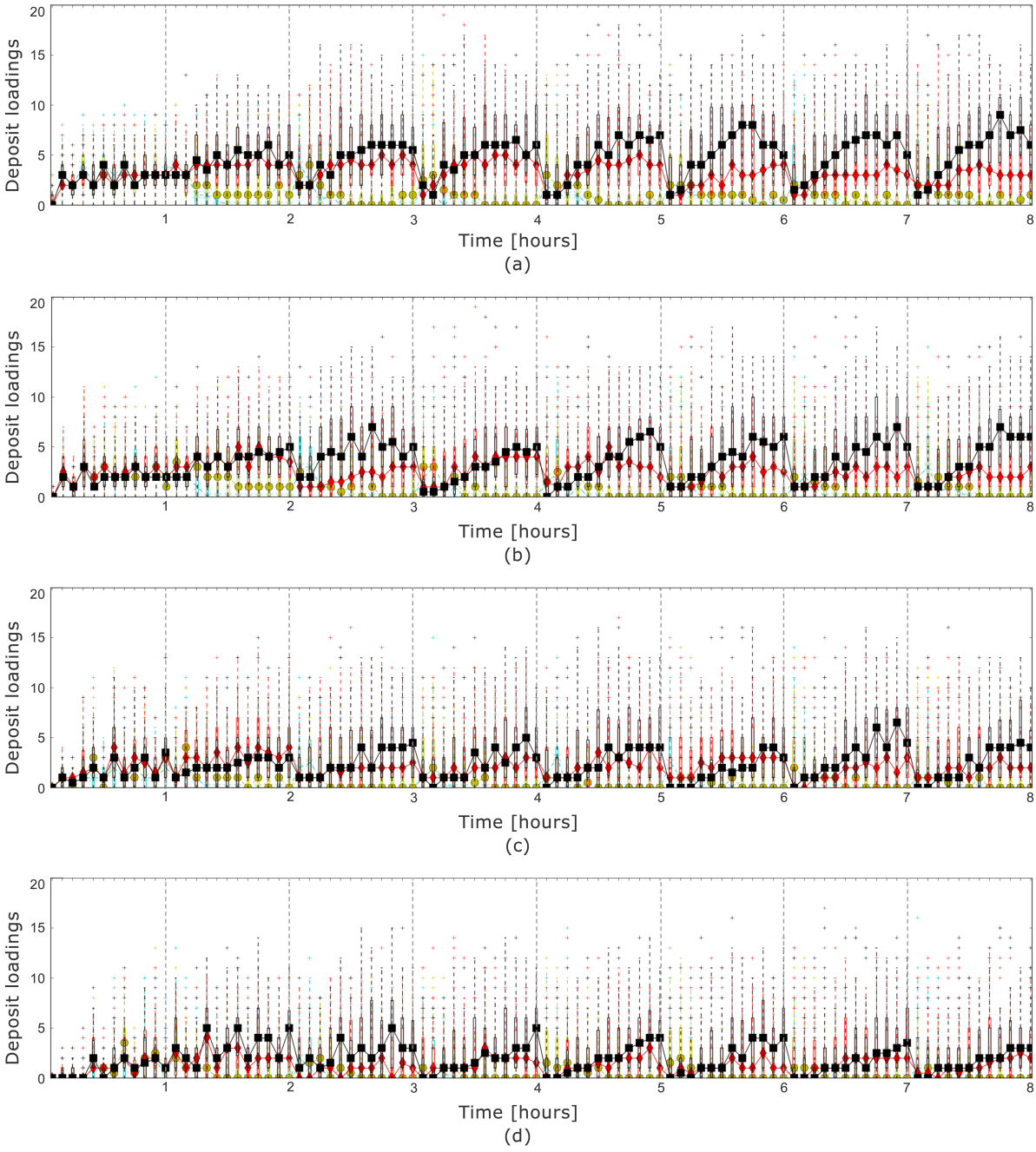


Figure S3: Median number of loadings from four deposits during the first eight hours of simulation using 25 short-range checkers in the Heap4B scenario with $T_Q = 1$ h and (a) $D = 7$ m, (b) $D = 9$ m, (c) $D = 11$ m, (d) $D = 13$ m. Deposit qualities were assigned randomly every hour during the experiment. Therefore, instead of identifying loadings from a particular deposit in a particular location, like in Figure S2, each symbol identifies loadings from a deposit of a particular quality in a given time interval: $Q = 1.9$ (squares), $Q = 1.5$ (diamonds), $Q = 0.5$ (circles), $Q = 0.1$ (crosses).

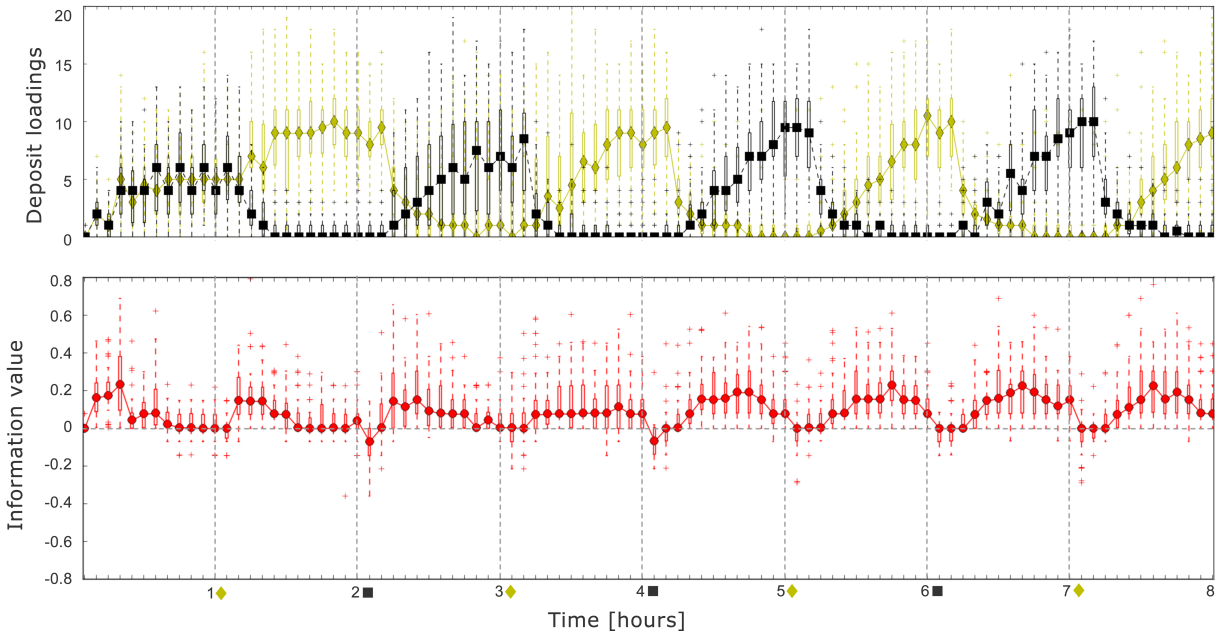


Figure S4: Median number of loadings from two deposits (square and diamond symbols) and information value of 25 short-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m. Deposit qualities were exchanged every hour during the experiment. The symbol of the deposit with higher quality is shown along the time axis at the beginning of each hour.

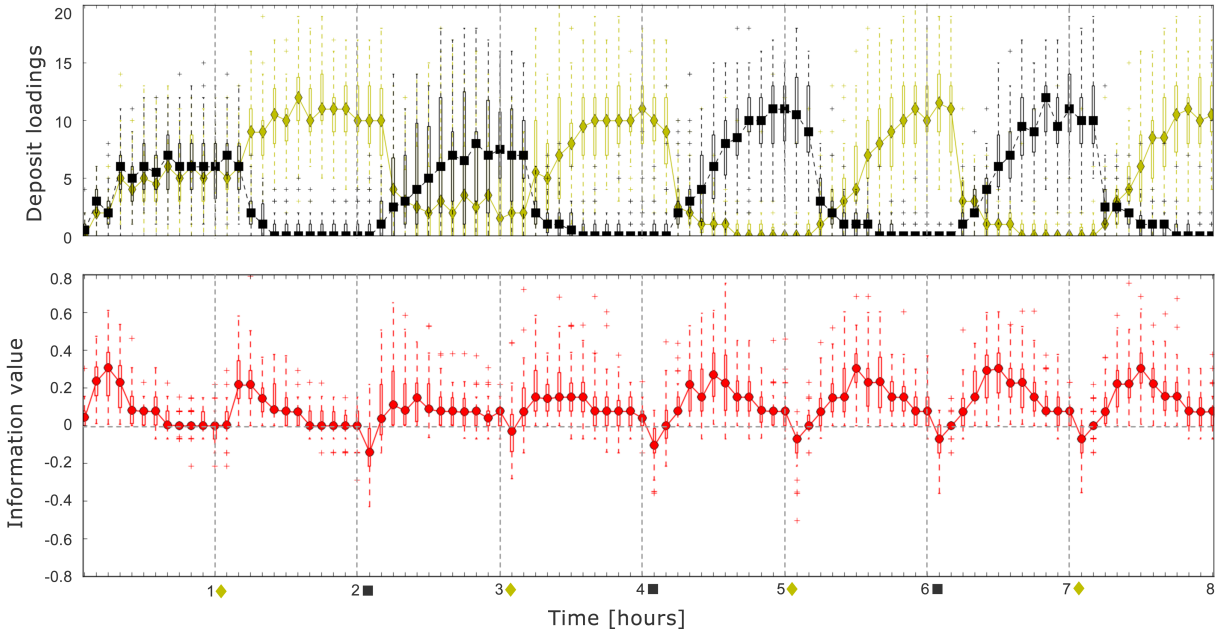


Figure S5: Median number of loadings from two deposits (square and diamond symbols) and information value of 25 short-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 7$ m. Deposit qualities were exchanged every hour during the experiment. The symbol of the deposit with higher quality is shown along the time axis at the beginning of each hour.

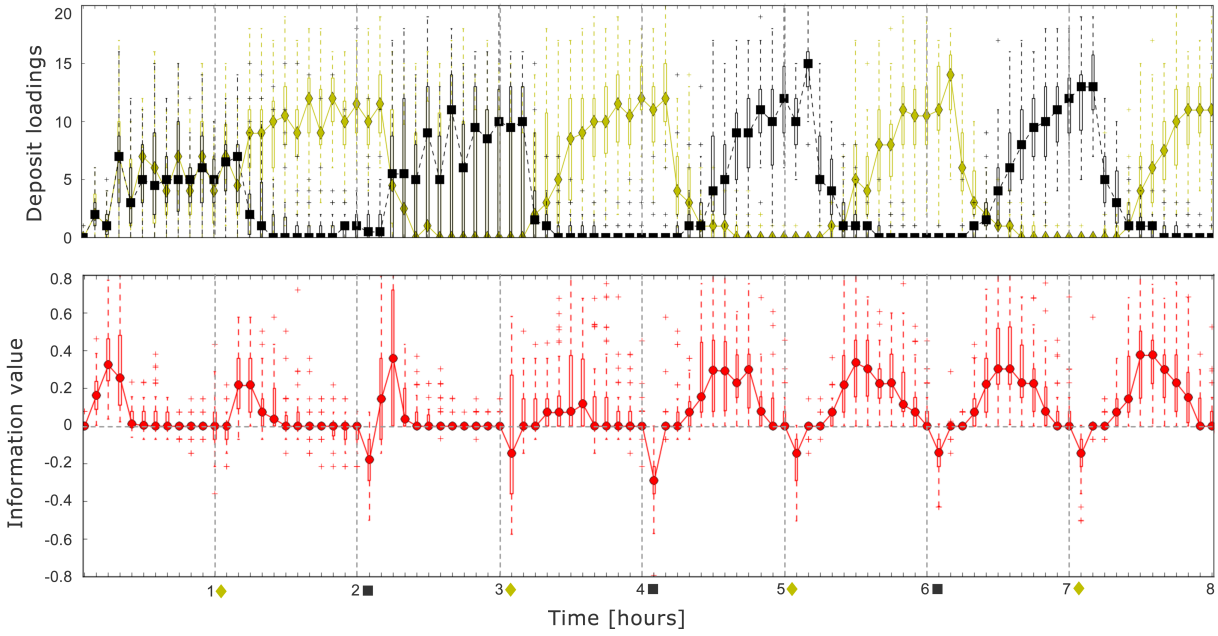


Figure S6: Median number of loadings from two deposits (square and diamond symbols) and information value of 25 long-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m. Deposit qualities were exchanged every hour during the experiment. The symbol of the deposit with higher quality is shown along the time axis at the beginning of each hour.

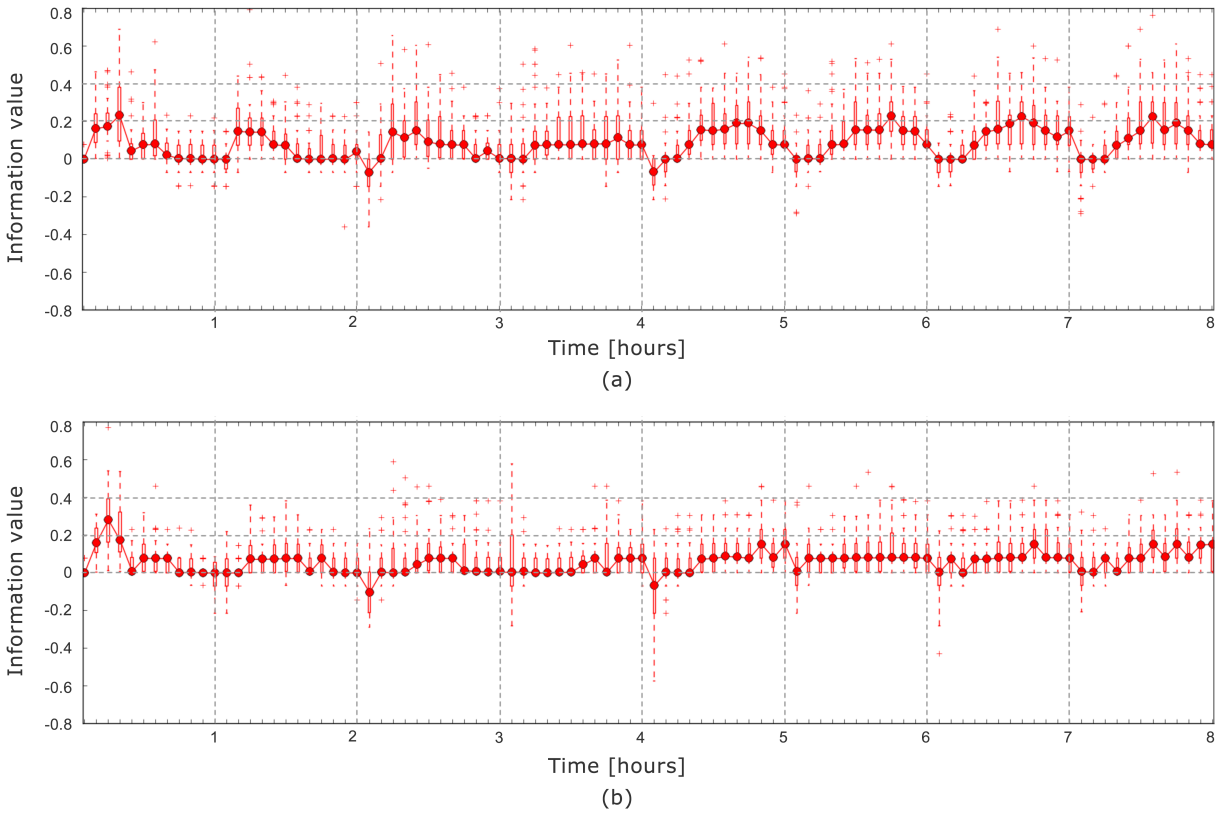


Figure S7: Information value of 25 short-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m and (a) normal dance floor shape, (b) restricted dance floor shape

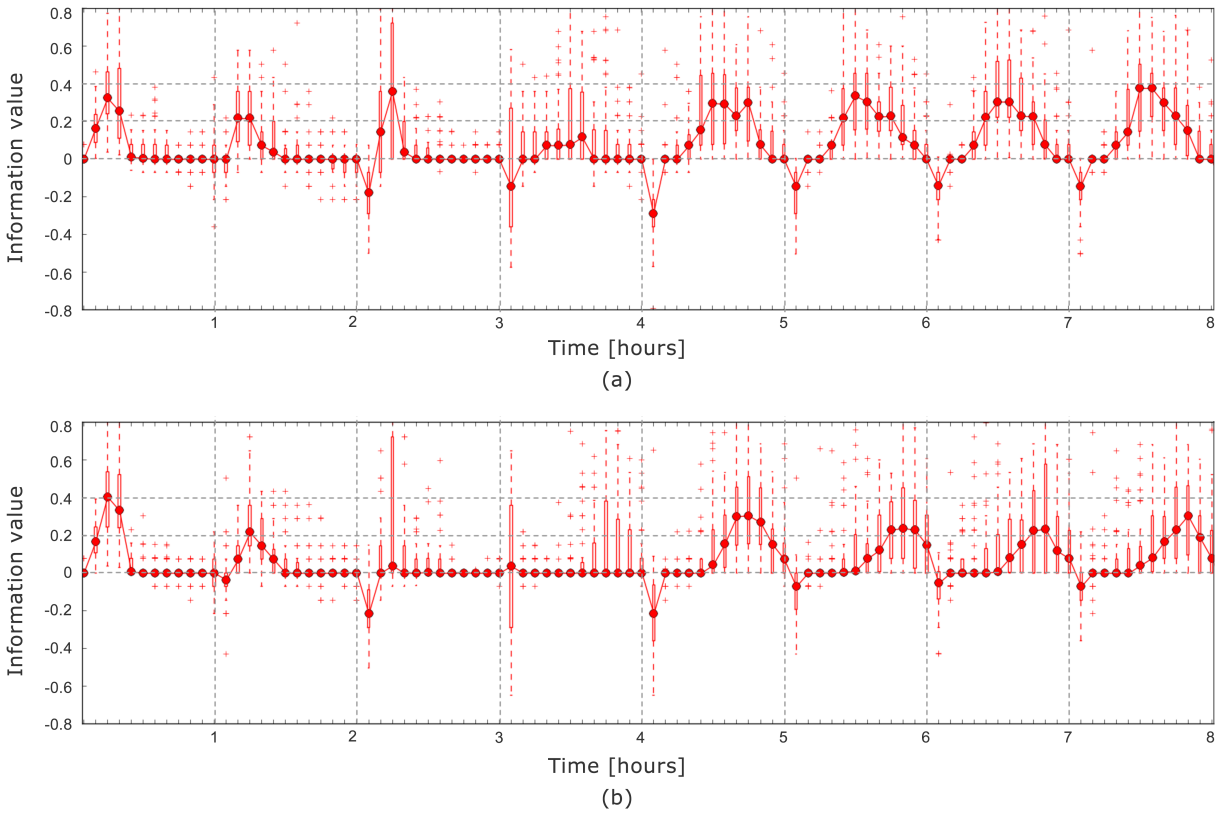


Figure S8: Information value of 25 long-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m and (a) normal dance floor shape, (b) restricted dance floor shape

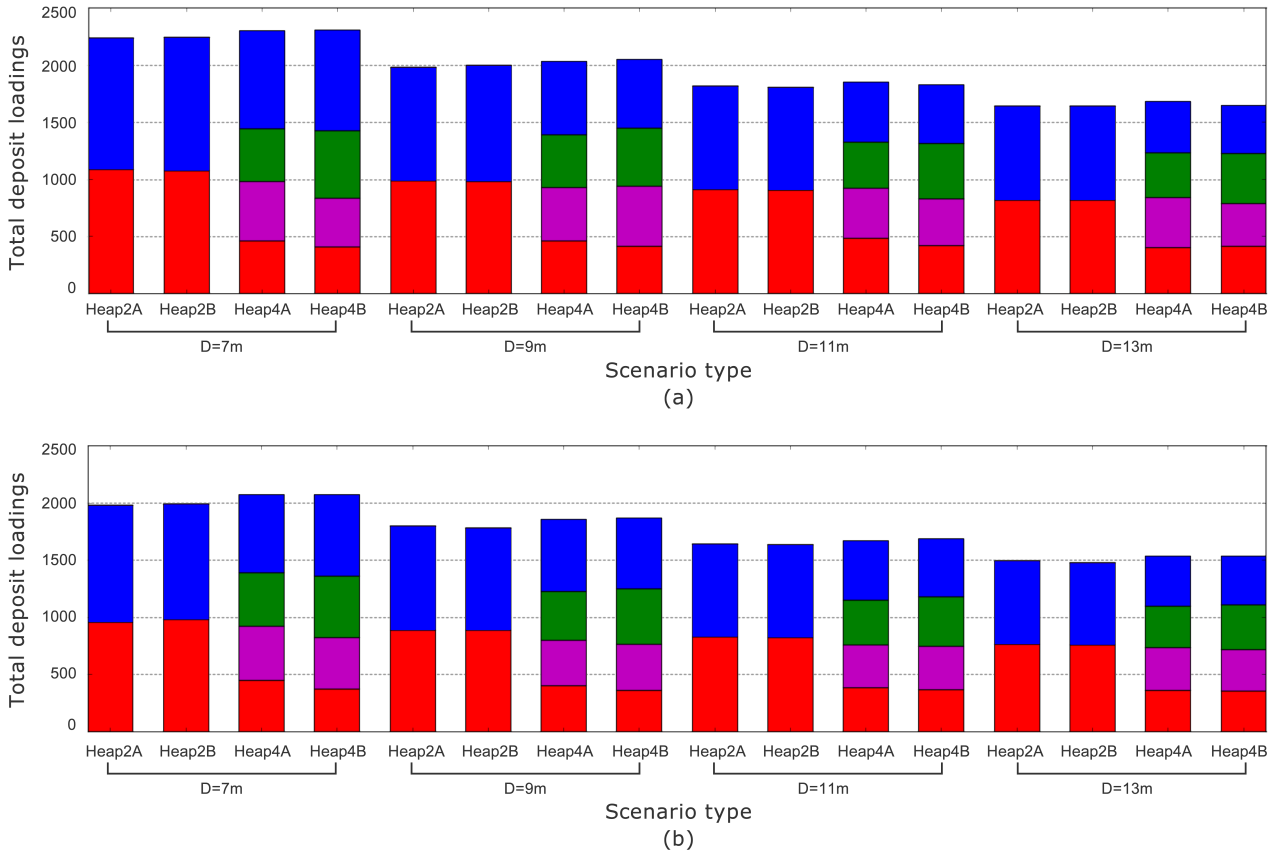


Figure S9: Total number of loadings from deposits of different qualities in various scenarios using 25 short-range beggers, $T_Q = 1$ h and (a) normal dance floor shape, (b) restricted dance floor shape. Since deposit qualities changed over time, instead of identifying loadings from a particular deposit in a particular location, each bar colour identifies loadings from a deposit of a particular quality. The bars for each scenario are ordered starting from the best deposit quality at the top, towards the worst deposit quality at the bottom.

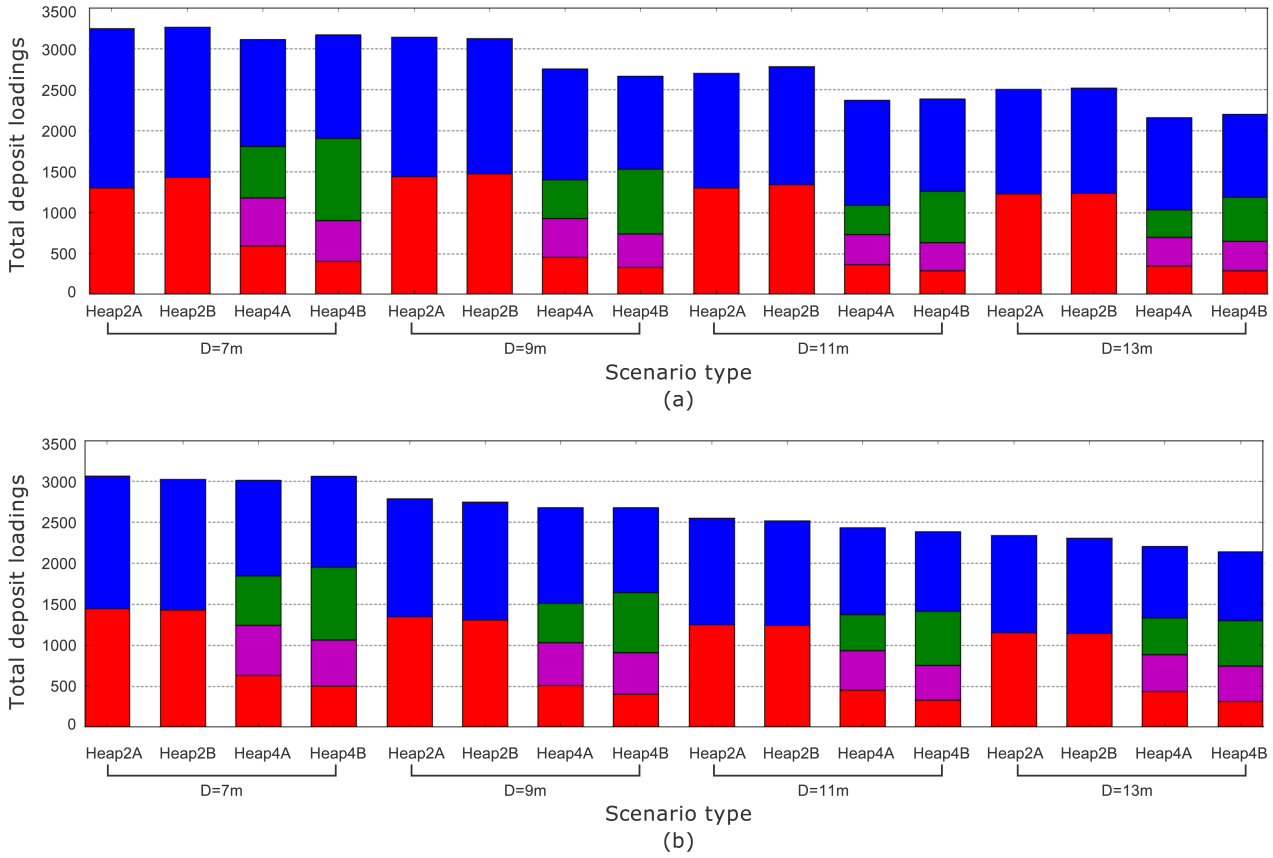


Figure S10: Total number of loadings from deposits of different qualities in various scenarios using 25 short-range beggers, $T_Q = 2$ h and (a) normal dance floor shape, (b) restricted dance floor shape. Since deposit qualities changed over time, instead of identifying loadings from a particular deposit in a particular location, each bar colour identifies loadings from a deposit of a particular quality. The bars for each scenario are ordered starting from the best deposit quality at the top, towards the worst deposit quality at the bottom.

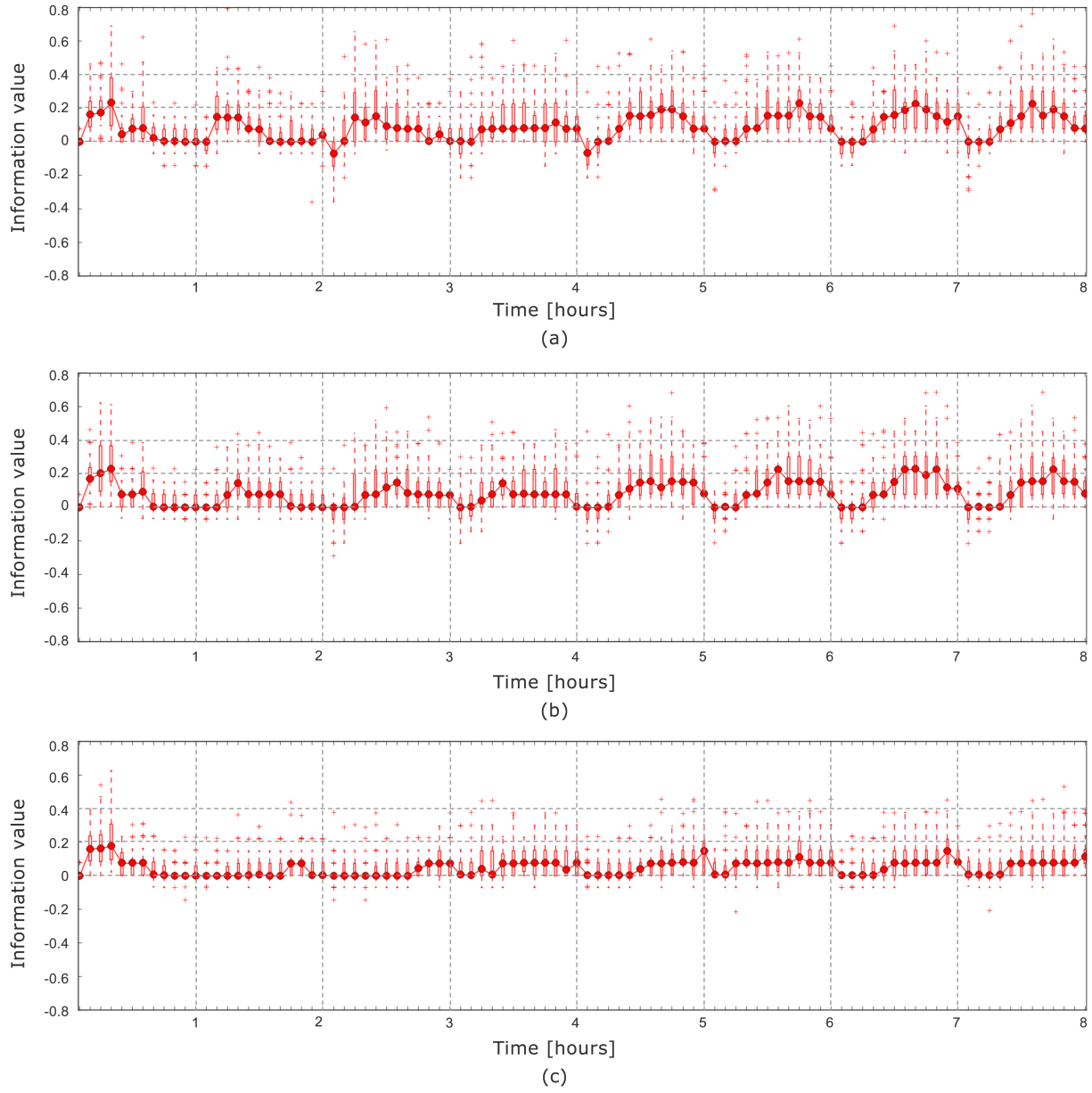
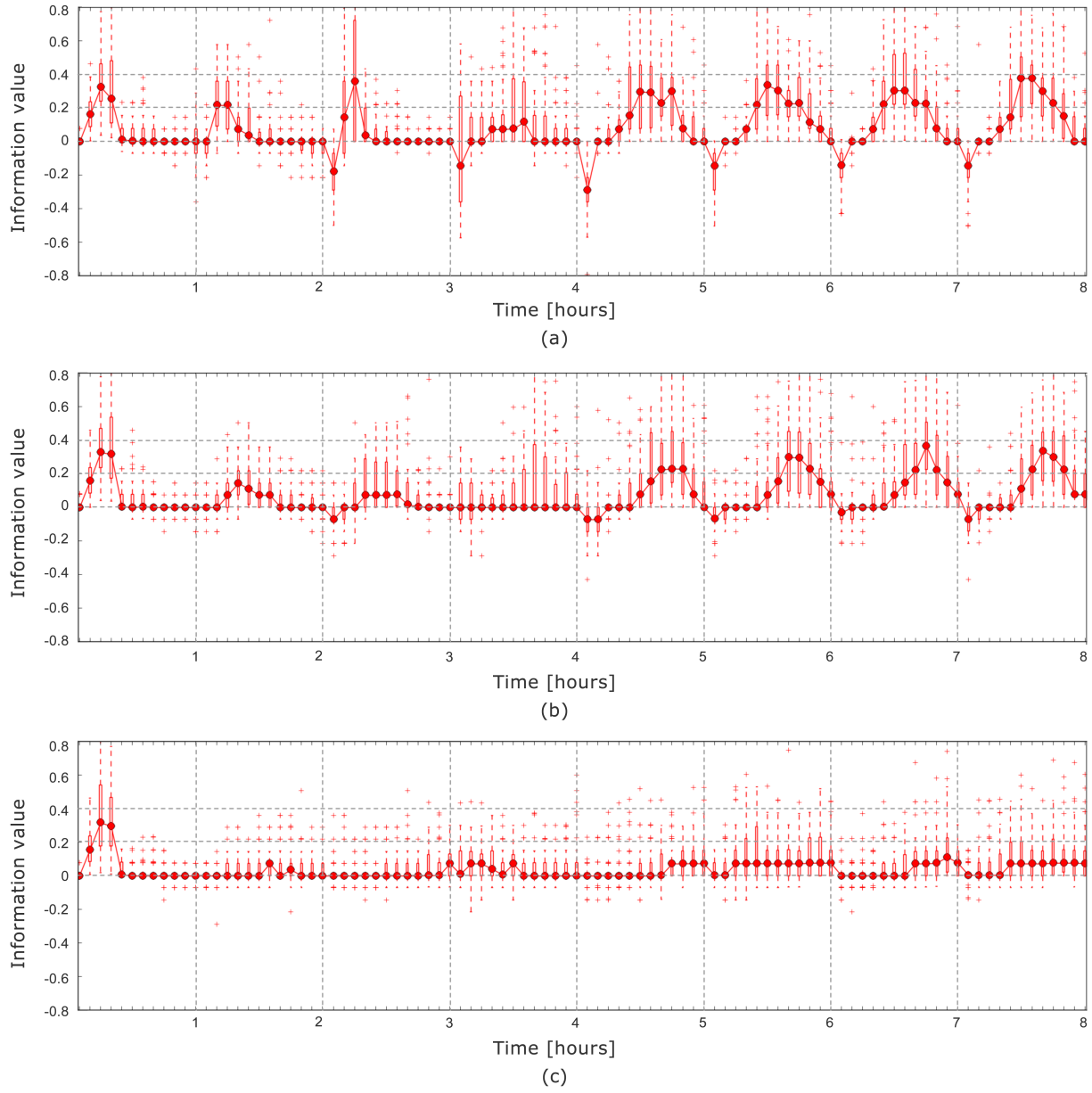


Figure S11: Information value of 25 short-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m and (a) no pellet accumulation, (b) $t_H = 10$ s, (c) $t_H = 20$ s



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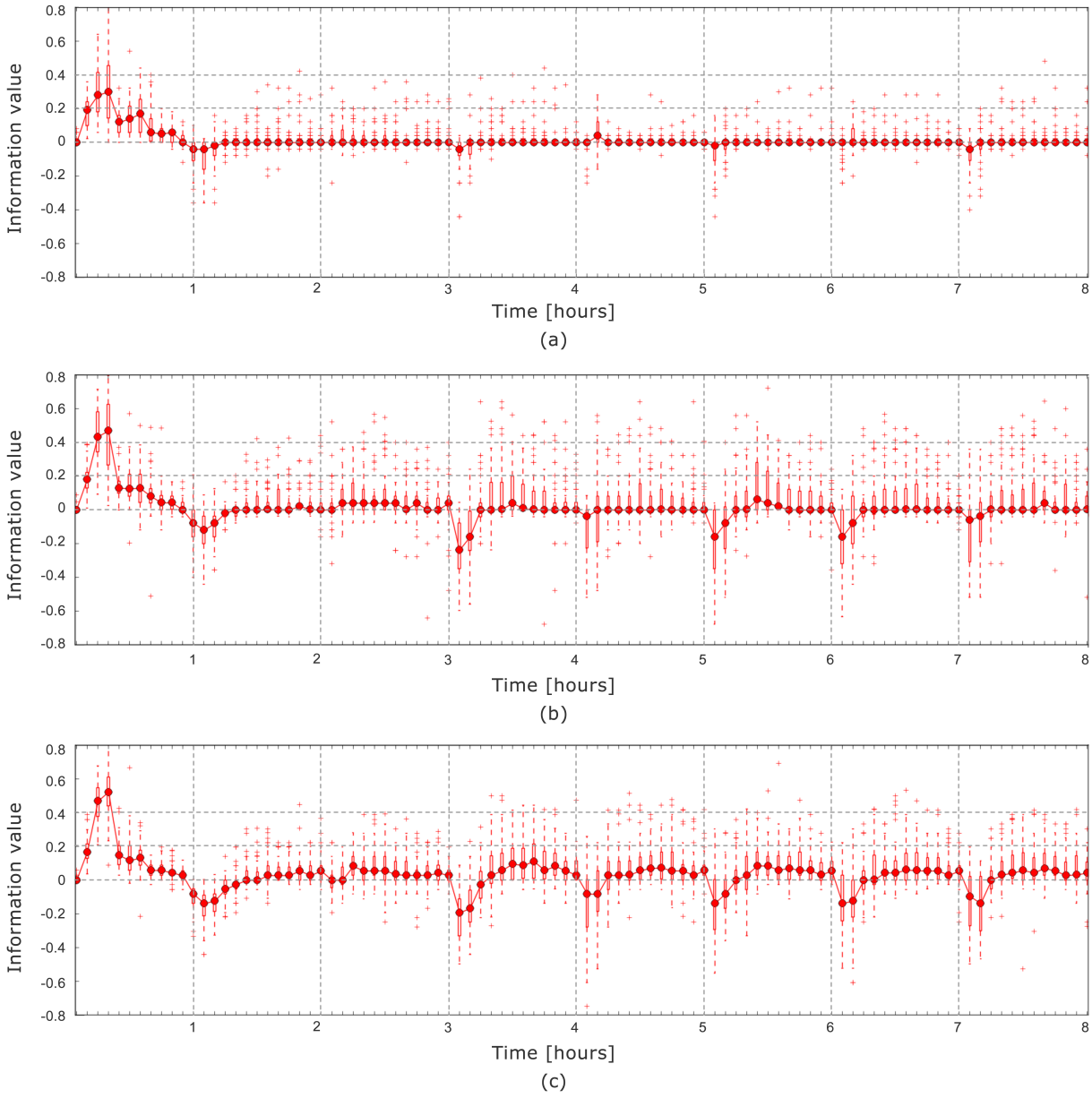

Figure S13: Information value of short-range beggers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m and (a) $N_R = 25$, (b) $N_R = 45$, (c) $N_R = 65$

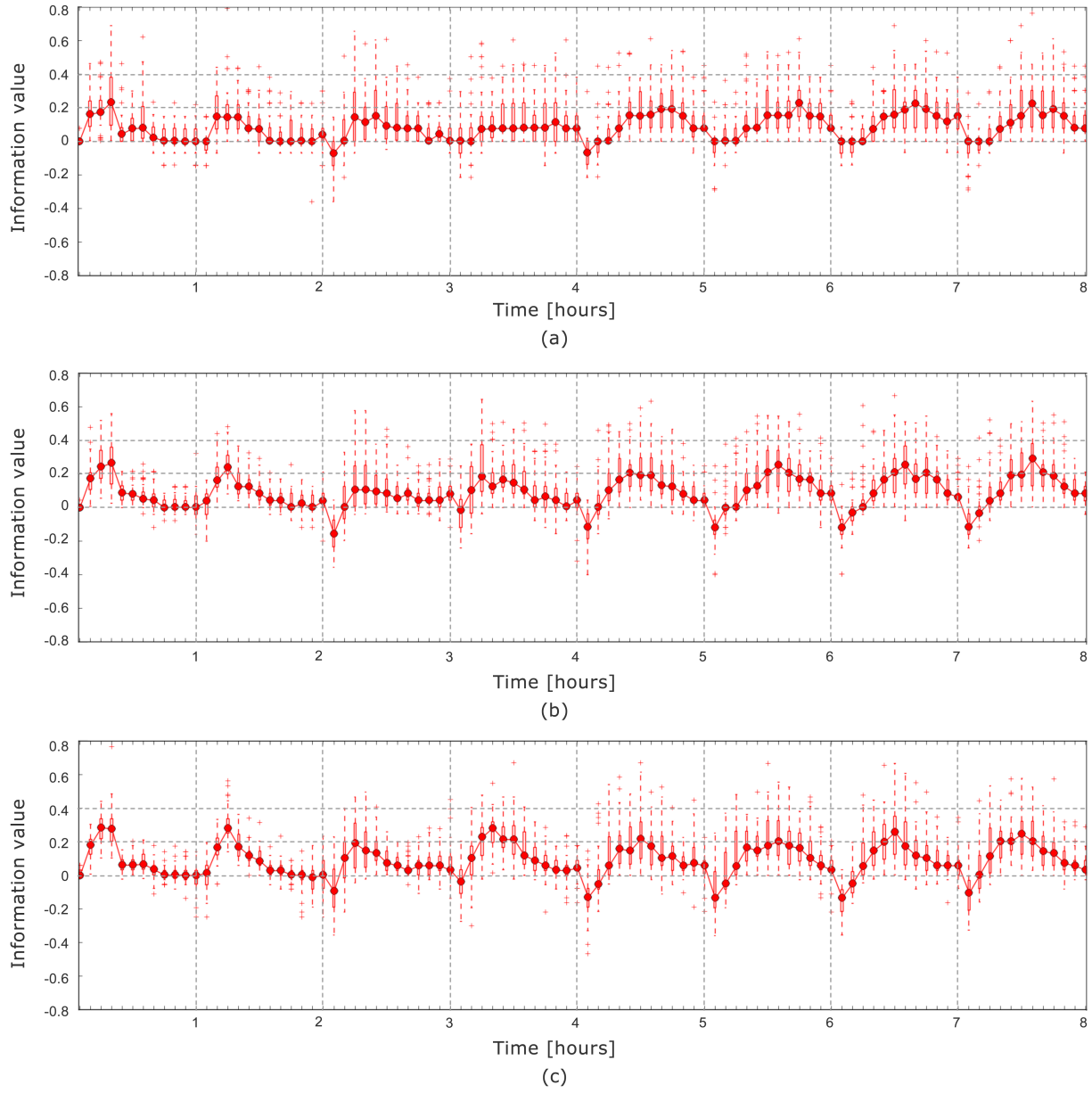

Figure S14: Information value of short-range checkers during the first eight hours of simulation in the Heap2B scenario with $T_Q = 1$ h, $D = 9$ m and (a) $N_R = 25$, (b) $N_R = 45$, (c) $N_R = 65$