Supplementary Material

Details about calculating $|CCC(t_m)|$

The equations used for calculating $|CCC(t_m)|$ are mentioned below for reference:

$$|CCC(t_m)| = \sum_{i=1}^{N} \sum_{j=1}^{N} \frac{C_{ij}(t)}{(N^2 - N)} \qquad \forall\, i \neq j \tag{1}$$

$$C_{ij}(t) = max(|\rho_{v_i v_j}(\tau)|) \qquad \forall\, -1.5s \leqslant \tau \leqslant 1.5s \tag{2}$$

$$\rho_{xy}(\tau) = \frac{E[x(t) - \mu_x)(y(t+\tau) - \mu_y)]}{\sigma_x \times \sigma_y} \qquad \forall\, t \in [t_l, t_u] \tag{3}$$

In Figure 1, a schematic of the various timescales involved in the calculation of $|CCC(t_m)|$ are presented. The timeseries in red, black and blue correspond to the speed timeseries of the 1st, 7th and 15th particle respectively. As can be seen in Figure 1, a sudden increase in speed in one particle's timeseries propagates and causes other particles to burst into motion after a finite delay. In the three (1st, 7th and 15th) particles' timeseries shown in Figure 1, different "bursts" in the ensemble have different originating points, hence the order in which these three particles' speed rises and falls may be different for each burst. For example, during "burst" **A** marked in Figure 1, the speeds of the three particles rise in the order $1st \rightarrow 15th \rightarrow 7th$, while during "burst" **B**, they rise in the order $15th \rightarrow 7th \rightarrow 1st$.

T_{win}

The first timescale of importance is the time window $T_{win} = t_u - t_l$ which is used to calculate one data point of the $|CCC(t_m)|$ timeseries. This value is taken such that it contains multiple "bursts" of activity in each section. One requires multiple "bursting events" in one section of the timeseries, so that the calculation of cross-correlation can compare the occurrence of multiple peaks in the speed timeseries of each particle. As shown in Figure 3 of the main manuscript, time evolution of $|CCC(t_m)|$ is calculated for three different values of T_{win}.

$T_{refractory}$

The average time period between two "bursts" of activity is the $T_{refractory}$ of the system. This is intrinsic to the ensemble and is around 10-15s. Since one requires multiple peaks to be present in each section of the timeseries being compared, T_{win} needs to be at least 2-3 times $T_{refractory}$.

τ

The timescale τ is to account for the finite propagation delay of activity from one part of the ensemble to the other. Therefore, it is roughly of the order of the time taken for the ensemble to finish one "burst" of activity.

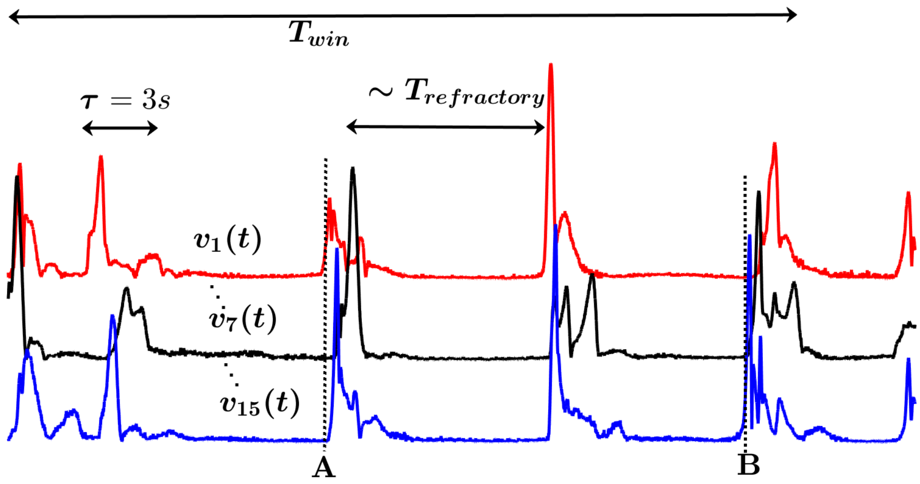

Figure 1: Schematic figure showing the various timescales involved in the calculation of $|CCC(t_m)|$.

Calculation of A_f

The height of the fundamental harmonic A_f presented in Figure 6a of the main manuscript was calculated with respect to the mean height of the background on both sides of the fundamental harmonic. Figure 2 visually demonstrates one such calculation of A_f.

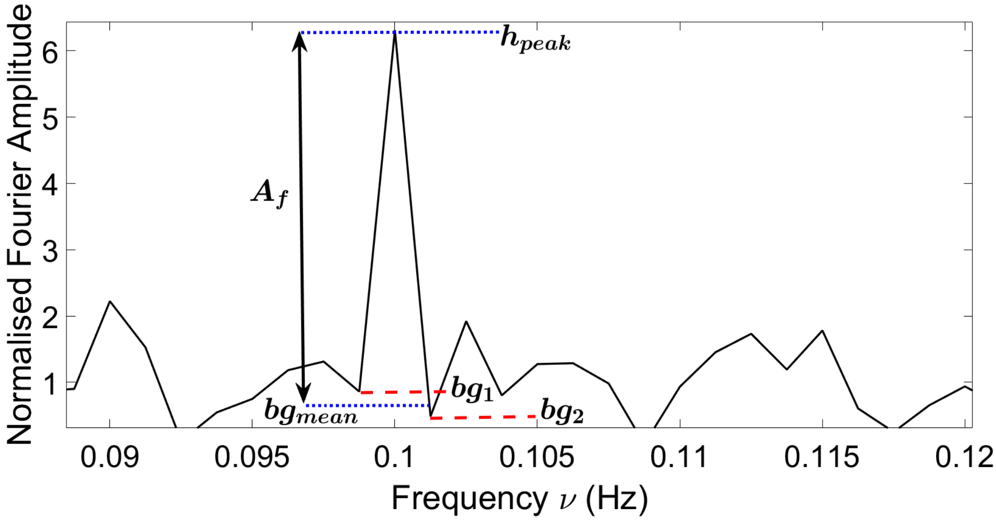

Figure 2: Schematic figure showing the calculation of A_f. h_{peak} is the height of the fundamental harmonic. bg_1 and bg_2 are heights of the background to the left and right of the fundamental harmonic. bg_{mean} is the mean value of bg_1 and bg_2.

Gauging the role of air-pump as a forcing

Experiments were performed to gauge the role of the air-pump as a forcing to the autonomous ensemble. Two measurements were performed for this purpose. Firstly, the response of an ensemble of camphor infused active paper disks ("active" ensemble) to the air-pump's disturbance was recorded. Secondly, an ensemble of identical paper disks without any camphor infused within them ("passive" ensemble) was perturbed with the air-pump. Figure 2 below compares the ensemble average timeseries of the "active" (blue) and the "passive" (red) ensemble in response to a forcing at $\Omega = 0.1$ Hz. One can clearly see that the "active" ensemble's average speed in response to the forcing is one order of magnitude higher than that of a "passive" ensemble. Similar differences can be observed in Figure 3, where the Fourier spectra of the ensemble's average speeds are compared. Therefore, one can infer from these observations that the air-pump plays the role of a mere trigger of activity in the enesemble and not as a significant source of kinetic energy.

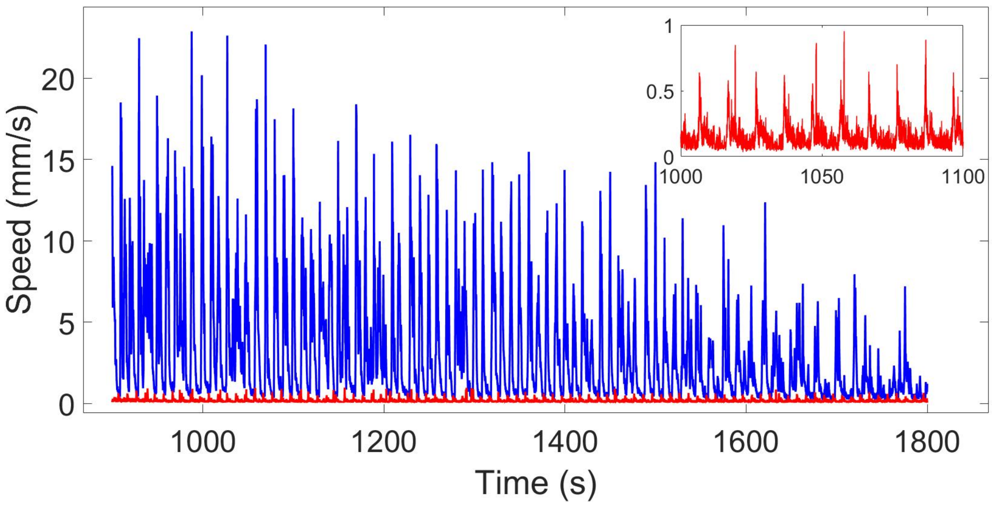

Figure 3: Ensemble average speed timeseries for an "active" (blue) and a "passive" (red) ensemble, in response to a forcing at $\Omega = 0.1$ Hz. Inset: Zoomed in view of the "passive" ensemble's average speed timeseries.

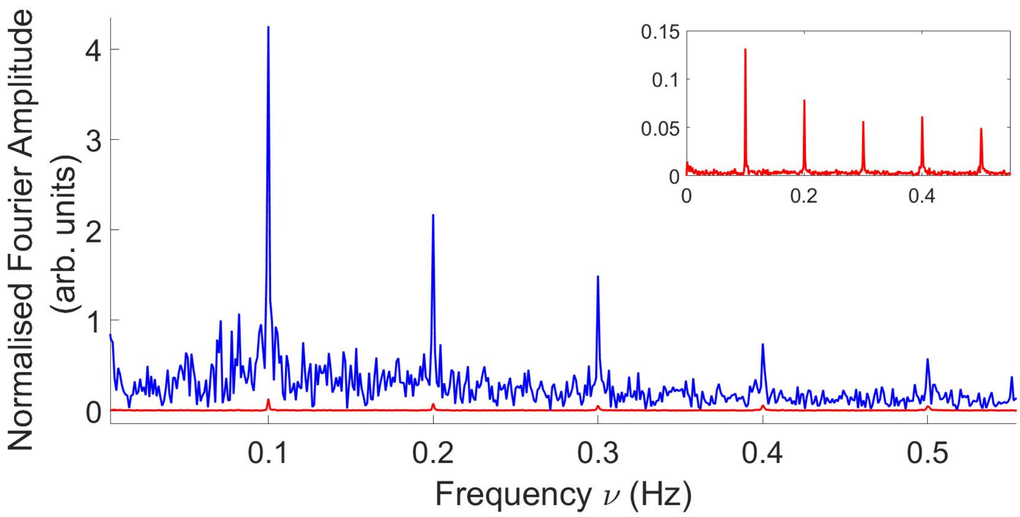

Figure 4: Fourier Spectra of the Ensemble's average speed for an "active" (blue) and a "passive" (red) ensemble, in response to a forcing at $\Omega = 0.1$ Hz. Inset: Zoomed in view of the Fourier spectra of the "passive" ensemble's average speed.