The following files from the study *"Synchronized locomotion can improve spatial accessibility inside ant colonies."* have been collected in three folders titled "Empirical data, Model output data, and Model & analysis code":

Empirical data – This folder contains data from our observations and analyses of *Leptothorax* ant colonies.

1. **Optical_flow_in_nest_RN23.csv** – The summed optical flow magnitudes for pixels associated with the locations of inactive ants and randomly chosen pixels from the 2.8-minute video clip of colony RN23.

2. **Optical_flow_in_nest_RN22.xls** – The summed optical flow magnitudes for pixels associated with the locations of inactive ants and randomly chosen pixels from the twenty 1-minute video clips from colony RN22. Each sheet of the file (N = 20) contains the data from the corresponding 1-minute segment.

3. **larval_tending_times.csv –** A file indicating the times (in seconds from the start of the recording) that a selection of 20 larvae (l1-l20) were interacted with by adult ants in colony RN19.

4. **larval_tending_smoothed.csv** – The time series of the total number of grooming and feeding interactions received by the 20 tracked larvae (see file **larval_tending_times.csv**) during the first 3 hours of the video recording of colony RN19. All the data points in the time series are in 30sec intervals. The time series has been smoothed with a Gaussian-weighted moving average with a window size of 15 data points.

5. **activity_MLD_RN1.csv … activity_MLD_RN23.csv** – Separate files containing the time series of collective activity and the time series of maximum local density (*MLD* and its proportional version *pMLD*) for the colonies used in this study. All the data points in the time series are in 30sec intervals. To calculate MLD, the cropped video frames that contained the nest cavity were divided into 16 sectors, each sector being 68x68 pixels.

6. **activity_MLD_RN22_32_sectors.csv** – A file containing the time series of collective activity and the time series of maximum local density (*MLD* and *pMLD*) for colony RN22 where *MLD* was calculated using 32 grid sectors, each sector being 68x34 pixels. This was file was used in our assessment of how the qualitative trends in our results might change depending on the way we calculated our spatial accessibility metric. All the data points in the time series are in 30sec intervals.

7. **activity_MLD_RN22_8_sectors.csv** – A file containing the time series of collective activity and time series of maximum local density (*MLD* and *pMLD*) for colony RN22 where *MLD* was calculated using 8 grid sectors, each sector being 68x136 pixels. This was file was used in our assessment of how the qualitative trends in our results might change depending on the way we calculated our spatial accessibility metric. All the data points in the time series are in 30sec intervals.

8. **Table_S1.csv** – A file containing Table S1 from the supplementary material, which is required for some of the statistical analyses carried out in the R script.

9. **Optical_flow_brood_pile_barrier.xls** – A file containing the empirical data on the summed optical flow magnitudes for pixels associated with the locations of inactive ants and pixels immediately adjacent to inactive ants in each colony's brood pile. Each sheet of the file (N = 19) contains the data from the corresponding colony's activity cycle that was chosen for detailed optical flow analysis. Each row of a sheet represents one 30 second interval of time. The column "*Inactive_ants*" reports the sum of the optical flow magnitudes for all pixels associated with inactive ants in the brood pile during each 30 second interval. Column "*Adjacent_locations*" reports the sum of the optical flow magnitudes for all pixels immediately adjacent to the inactive ants in the brood pile during each 30 second interval.

10. **Optical_flow_brood_pile_coverage.xls** – A file containing the empirical data on the presence of inactive ants and the spatial extent of activity in each colony's brood pile. Each sheet of the file (N = 19) contains the data from the corresponding colony's activity cycle that was chosen for detailed optical flow analysis. Each row of a sheet represents one 30 second interval of time. The column "*No_of_inactive_ants*" reports the approximate number of inactive ants in the focal colony's brood pile, and the column "*Brood_coverage*" reports the proportion of sectors (150 sectors total) in the brood pile with active ants present.

11. **Optical_flow_in_nest_all_colonies_1min.xls** – The summed optical flow magnitudes for pixels associated with the locations of inactive ants and randomly chosen pixels from the 1-minute video clips from all 19 colonies. Each sheet of the file (N = 19) contains the data from the corresponding colony's 1-minute segment.

12. **img_RN1 … img_RN23** – Separate folders containing the frames in the image sequence from the recordings of each colony used in this study. The frames have been reduced in size from their original resolution of 720x1280 pixels.

13. **RN23_optical_flow_images** – A folder containing the image files used for the optical flow analysis on colony RN23.

14. **RN22_optical_flow_images** – A folder containing the image files used for the optical flow analysis on colony RN22. The frames have been reduced in size from their original resolution of 720x1280 pixels.

15. **RN1_cycle_image … RN23_cycle_image** – Separate folders containing the image files from the activity cycle of each colony (1 cycle chosen per colony) that were targeted for detailed optical flow analysis. The frames have been reduced in size from their original resolution of 720x1280 pixels.

Model output data – This folder contains data produced by our computational model.

1. **MLD_activity_simulation_R0.5_1.csv** – File containing the time series of collective activity (total number of active ants) and the time series of maximum local density (*MLD* and its

proportional version *pMLD*) from a simulation run of our model. To calculate MLD, the simulation arena was divided into 16 sectors. The parameters of the simulation were: $A = 100$, $R = 0.5$, $L = 30$, and $N = 120$ agents.

2. **MLD_activity_simulation_R0.5_2.csv** – File containing the time series of collective activity (total number of active ants) and the time series of maximum local density (*MLD* and its proportional version *pMLD*) from a simulation run of our model. To calculate MLD, the simulation arena was divided into 16 sectors. The parameters of the simulation were: $A = 100$, $R = 0.5$, $L = 30$, and $N = 120$ agents.

3. **MLD_activity_simulation_R0.csv** – File containing the time series of collective activity (total number of active ants) and the time series of maximum local density (*MLD* and its proportional version *pMLD*) from a simulation run of our model. To calculate MLD, the simulation arena was divided into 16 sectors. The parameters of the simulation were: $A = 100$, $R = 0$, $L = 30$, and $N = 120$ agents.

Model & analysis code – This folder contains the Python code of our mobile phase oscillator model along with the R and MATLAB scripts we used to process and analyze our empirical and simulated data.

1. **Mobile_oscillator_spatial_accessibility.py** – The main Python code that implements the agent-based model.

2. **classAnt.py** – Python code used by the main model (Mobile_oscillator_spatial_accessibility.py) that defines the algorithm followed by individual ants (agents).

3. **spatial_accessibility_analysis.R** – An R script that contains all of the statistical tests performed in the study.

4. **optical_flow_obstacle_analysis_RN23.m** – A MATLAB script that performs optical flow analysis on the clip from colony RN23 to assess whether inactive ants can block the motion of active ants.

5. **optical_flow_obstacle_analysis_RN22.m** – A MATLAB script that performs optical flow analysis on clips from colony RN22 to assess whether inactive ants can block the motion of active ants.

6. **nest_spatial_image_analysis.m** – A MATLAB script that obtains the collective activity and the max local density (*MLD* and its proportional version *pMLD*) time series from the colony image sequences.

7. **Leptothorax_period_estimates.m** – A MATLAB script that performs wavelet analysis on the colony activity time series to determine the dominant oscillation period for each of the 19 colonies.

8. **optical_flow_obstacle_analysis_all_colonies.m** – A MATLAB script that performs optical flow analysis on 1-min clips from all 19 colonies to assess whether inactive ants can block the motion of active ants.

9. **optical_flow_obstacle_analysis_brood_piles.m** – A MATLAB script that performs the optical flow analysis on brood piles from all 19 colonies to assess whether inactive ants can constrain what parts of the brood pile that active ants are able to physically access.