Matlab code used for "Collective thermoregulation of bee clusters"

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There are two separate(although related) programs. The simpler of the two is "EffectofFiniteBeeSize", used to calculate the result in Appendix E. I recommend you look at this code first, as it has the same basic structure as the other, but is *much* simpler as it does not consider convection, is spherically symmetric, and does not contain stability analysis. "MainPaperCode" is the more complicated of the two which is used for everything else, and includes solving for air flow and stability analysis.

I. FINITE BEE SIZE

A brief summary of files:

- solveForClusterProfiles is the outermost routine, it solves for temperature and density profiles at a variety of ambient temperatures and bee numbers. You can set the options for ambient temperatures, effective bee length, and cluster size here.

- IterativeSolver is the method described in Appendix C1. It calls calculateRho to calculate density at fixed temperature, and then CalculateTemp to calculate temperature at fixed density.

- calculateEffectiveAmbientT calculates the temperature a certain distance below the surface of the cluster.

- plotClusterRadii, plotCoreTempAndRadius display the core temperatures and radii. DisplayProfile displays the temperature and density profile for a single simulated cluster.

- updatePositionParameters is a helper method to keep track of the cell volumes, areas, widths, and positions.

II. MAIN PAPER CODE

This is the code used in the main part of the paper, as well as all supplementary material except for Appendix E. A brief summary of files:

- doEverything is a simple routine that calls the other outermost routines of solveForClusterProfiles, displayResults, calculateAllHessians, calculateAllMaxEigs, showSomeEigenvectors. You can call these routines on your own, but note that the earlier routines create files that the later routines depend on.

- solveForClusterProfiles solves for temperature and density profiles at a variety of ambient temperatures and bee numbers. You can set the options for ambient temperatures, effective bee length, etc. here. It puts the results into ClusterProfileOutput/SavedResults.mat.

- displayResults loads the data from ClusterProfileOutput/SavedResults.mat and plots cluster profiles, etc. and saves them in the DisplayedResults folder.

- calculateAllHessians loads the data from ClusterProfileOutput/SavedResults.mat, calculates the linear response matrices, and puts the results into CalculatedHessians, as well as saving a few options into StabilityResults(A bit of a misnomer).

- calculateAllMaxEigs loads the data from ClusterProfileOutput/SavedResults.mat, CalculatedHessians, as well as StabilityResults, and calculates the maximum real part of the eigenvalues to see if there is a linear instability.

- showSomeEigenvectors puts you into a menu where you can choose a mode and cluster size, and shows you eigenvectors for that mode.

- IterativeSolver is the method described in Appendix C1. It calculates density at fixed temperature, temperature at fixed density, and then iterates until it approaches a solution.

If anything isn't clear or you have questions about the code, please do not hesitate to contact samocko@gmail.com.