Abstract Submitted
for the 4CS20 Meeting of
The American Physical Society

Dynamic Stomatal Patchiness: Parallel Behavior in Computation and Nature[1] MATTHEW HOGAN, DAVID PEAK, KEITH MOTT, Utah State University — Previous studies have suggested that some biological processes are equivalent to computation, and the evidence for this view is growing. Plants must simultaneously and continuously regulate the apertures of all their stomata, allowing for sufficient CO_2 uptake for photosynthesis while limiting the loss of water vapor outflow. Thermography has shown that sudden changes to light or humidity cause stomata to spontaneously form local patches that oscillate simultaneously. We examine the emergent properties of a model of stomatal activity, where a leaf is simulated as an array of locally interacting units. Individual units are modeled to solve the governing thermodynamic equations of gas and water transport within the guard cells and surrounding epidermal cells. The emergent behavior in this model suggests a simple explanation for the phenomenon of stomatal patchiness. Furthermore, the discussed model is of a similar design to a Cellular Neural Network (CNN); a computational paradigm in which individual units perform local tasks to accomplish or optimize global tasks. Simulated array data could support the argument for global optimization of CO_2 uptake to water vapor outflow, suggesting a decision making process may be present in plants.

[1]Thanks to the Peak Summer Research Fellowship

Matthew Hogan
Utah State University

Date submitted: 25 Sep 2020 Electronic form version 1.4