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Modeling Cellular Interactions in Plants[1] MATTHEW HOGAN, DAVID PEAK, Utah State University Department of Physics, KEITH MOTT, Utah State University Department of Biology — Plants must regulate a delicate exchange in order to survive: taking in enough carbon dioxide to photosynthesize while simultaneously limiting the loss of water to avoid dehydration. It is known that the regulators of this exchange are stomata, which are variable aperture pores found on the surface of leaves. We used a high resolution thermal camera to measure the temperatures across a small area of a leaf's surface, containing hundreds of thousands of stomata. We usually observed these data to be spatially "patchy," which is indicative of collective behavior of stomata. Based on these observations and what is known about stomatal physics, we developed a network of discrete differential-difference equations to model how stomatal units respond to various external inputs and internal interactions. This network is closely analogous to a distributed computational method called a Cellular Nonlinear Network. By both running simulations and performing experiments we are trying to see how close this analogy is; that is, we are trying to probe the question, is it possible that plants compute?

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