Nonlinearities in Plant Pigment Patterns

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Abstract

The beautiful pink, red, purple, and blue colors observed in flowers, fruits, leaves, and stems of the plant kingdom derive primarily from a class of cell pigments called anthocyanins. These biologically active chemicals play diverse roles in plant ecology and cell biology. In particular, pollinators recognize both the colors and spatial color patterns; alterations in the patterns due to pollutants or climate change have been implicated in plant-pollinator mismatches. Medicinally, anthocyanins are powerful antioxidants, as well as antihypertensive, antitumor, antidiabetic, and antifungal agents, and they are potential players in the defense against neurological disorders. Anthocyanins undergo an incredible number of reversible structural, and therefore color and functional, changes which are pH, temperature, light, and concentration dependent. Anthocyanins also undergo association reactions whereby they associate with each other to form larger complexes which impact their ecological and medicinal functions. In this talk, we provide experimental evidence for spatial variation in the degree of anthocyanin association in flower pigment patterns. We build a model for anthocyanin pattern formation that includes association and apply methods of topological data analysis combined with machine learning to compare the model to experimental data.