Probing the mystery of the Venus fly trap's botanical bite

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Plants lack muscles, yet in only a tenth of a second, the meat-eating Venus fly trap hydrodynamically snaps its leaves shut to trap an insect meal. This astonishingly rapid display of botanical movement has long fascinated biologists. Commercially, understanding the mechanism of the Venus fly trap's leaf snapping may one day help improve products such as release-on-command coatings and adhesives, electronic circuits, optical lenses, and drug delivery.

Now a team of French physicists from the National Center for Scientific Research (CNRS) and Aix-Marseille University in Marseille, France, is working to understand this movement. They will present their findings at 65th meeting of the American Physical Society's (APS) Division of Fluid Dynamics (DFD), Nov. 18 – 20, 2012, in San Diego, Calif.

The work extends findings by Dr. Yoël Forterre and researchers from Harvard University who discovered several years ago that the curvature of the Venus fly-trap's leaf changes while closing due to a snap-buckling instability in the leaf structure related to the shell-like geometry of the leaves. Mathieu Colombani, Ph.D. student in Forterre's laboratory is now conducting experiments to elucidate the physical mechanisms behind this movement. "The extremely high pressure inside the Venus fly trap cells prompted us to suspect that changes with a cell's pressure regime could be a key component driving this rapid leaf movement," he notes.

The Colombai team uses a microfluidic pressure probe to target and measure individual cells. This is a tricky experiment because it requires

the living plant to be immobilized with dental silicone paste while the probe is inserted using a micromanipulator guided by binoculars. They take pressure measurements before and after leaf closure. They also measure cell wall elasticity by injecting or removing a known amount of liquid and recording the cellular responses, as well as take other measurements. "By measuring osmotic pressure and elasticity of leaf cells we hope to come closer to explaining the snapping mechanism," Colombani explains.

More information: The talk, "How the Venus flytrap actively snaps: hydrodynamic measurements at the cellular level," is at 4:45 p.m. on Sunday, Nov. 18, in Room 28C.
http://absimage.aps.org/image/DFD12/MWS_DFD12-2012-000207.pdf

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