Mechanics

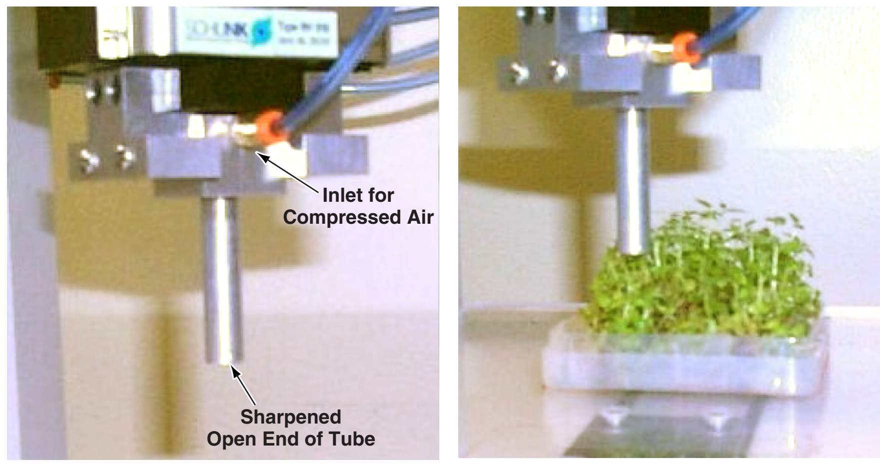
Device for Automated Cutting and Transfer of Plant Shoots

This device is simple yet effective.

NASA's Jet Propulsion Laboratory, Pasadena, California

A device that enables the automated cutting and transfer of plant shoots is undergoing development for use in the propagation of plants in a nursery or laboratory. At present, it is standard practice for a human technician to use a knife and forceps to cut, separate, and grasp a plant shoot. The great advantage offered by the present device is that its design and operation are simpler than would be those of a device based on the manual cutting/separation/grasping procedure. [The present device should not be confused with a prior device developed for partly the same purpose and described in "Compliant Gripper for a Robotic Manipulator" (NPO-21104), *NASA Tech Briefs*, Vol. 27, No. 3 (March 2003), page 59.]

The device (see figure) includes a circular tube sharpened at its open (lower) end and mounted on a robotic manipulator at its closed (upper) end. The robotic manipulator simply pushes the sharpened open end of the tube down onto a bed of plants and rotates a few degrees clockwise then counterclockwise about the vertical axis, causing the tube to cut a cylindrical plug of plant material. Exploiting the natural friction between the tube and plug, the tube retains the plug, without need for a gripping mechanism and control.



DEVICE ON ROBOTIC MANIPULATOR

DEVICE PUSHED DOWN ONTO PLANTS BY ROBOTIC MANIPULATOR

Pushed Down Onto a Bed of Plants, the tube cuts and retains a plug of plant material. There is no need for separate cutting and grasping mechanisms and their controls.

The robotic manipulator then retracts the tube, translates it to a new location over a plant-growth tray, and inserts the tube part way into the growth medium at this location in the tray. A short burst of compressed air is admitted to the upper end of the tube to eject the plug of plant material and drive it into the growth medium.

A prototype has been tested and verified to function substantially as intended. It is projected that in the fully developed robotic plant-propagation system, the robot control system would include a machine-vision subsystem that would automatically guide the robotic manipulator in choosing the positions from which to cut plugs of plant material. Planned further development efforts also include more testing and refinement of the design and operation described above.

This work was done by Raymond Cipra, NASA Summer Faculty Fellow from Purdue University, Hari Das and Khaled Ali of Caltech, and Dennis Hong of Purdue University for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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Extension of Liouville Formalism to Postinstability Dynamics

A fictitious stabilizing force is introduced.

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A mathematical formalism has been developed for predicting the postinstability motions of a dynamic system governed by a system of nonlinear equations and subject to initial conditions. Previously, there was no general method for prediction and mathematical modeling of postinstability behaviors (e.g., chaos and turbulence) in such a system.

The formalism of nonlinear dynamics does not afford means to discriminate between stable and unstable motions: an additional stability analysis is necessary for such discrimination. However, an additional stability analysis does not suggest any modifications of a mathematical model that would enable the model to describe postinstability motions efficiently. The most important type of instability that necessitates a postinstability description is associated with positive Lyapunov exponents. Such an instability leads to exponential growth of small errors in initial