CONTOUR MAPPING

In 1989-90, the Ohio State University Center for Mapping (CFM), one of NASA's Centers for the Commercial Development of Space, developed a vehicle known as the GPSVan System to meet a need for a cost-effective way of creating accurate highway maps from digitized data.

The "GPS" stands for Global Positioning System, a constellation of satellites operated by the Department of Defense to provide highly precise position information for aircraft, surface vessels and ground vehicles. The GPSVan is a mobile data collection system for mapping roads and their surroundings while driving at regular highway speeds; GPS receivers acquire satellite signals, which are computer processed on board the van, for a continuous record of the vehicle's location.

The van also has two video cameras, which scan the local terrain and produce images whose location is coordinated with the van's position at the time of imaging. Features such as street lights, utility poles, manholes and roadside structures can thus be positioned on the base maps. All this data is fed into a computerized Geographic Information System (GIS). The expense of switching map data to electronic databases is eliminated because the digitizing has already been done aboard the van.

The GPSVan has been used in commercial mapping operations but CFM continues to advance the technology. A novel and commercially promising advancement is the use of satellite positioning technology to determine the contours of a construction site. That was accomplished in a three-year project jointly conducted by CFM and George J. Igel & Company, Inc., Columbus, Ohio.

In 1994, Igel was able to use the GPS survey system to determine the contours of a construction site by driving over it in regular patterns. Using GPS receivers and

software produced by CFM, Igel employed an antenna-equipped pickup truck to collect data on ground elevations, which were recorded and registered as contours. The Igel/CFM team was able to cover about six acres per hour with complete contours plotted "on the fly." The data proved accurate to within one-tenth of a foot in all dimensions.

At left is a view of a vehicle based system at a construction site. A closeup of the base station receiver and antenna is shown **at right. Below** is a view of the vehicle-mounted antenna that receives the satellite signals, which are used to calculate the coordinates of points on the ground.

AMT Systems Engineering, one of CFM's industrial partners, designed the enclosure for the survey system; a more advanced final product has been configured for a backpack instead of the truck. The GPS survey system will be used to reduce the time required for mapping and staking, and to monitor the amount of soil moved on a given day.

Igel and CFM have continued development work on the construction application toward an eventual capability to obtain elevations while using earth-moving equipment. The team has conducted experiments in which GPS positioning is used to control a cutting blade on earth moving equipment for total site grading by means of digitized design information.

In these experiments, a computer and TV-like monitor display the digitized site design to the machine operator. Using GPS, the machine's position on the site is determined and communicated via the computer screen to the operator. By comparing the machine's position to the final design, the operator determines how much cutting and filling is required. A graphical user interface is being designed to assist the operator in evaluating the site and to support on-the-fly decision making. Igel and CFM envision a future system capable of feeding GPS signals and design information directly to the vehicle's hydraulic controls to automate the earth cutting and filling function.