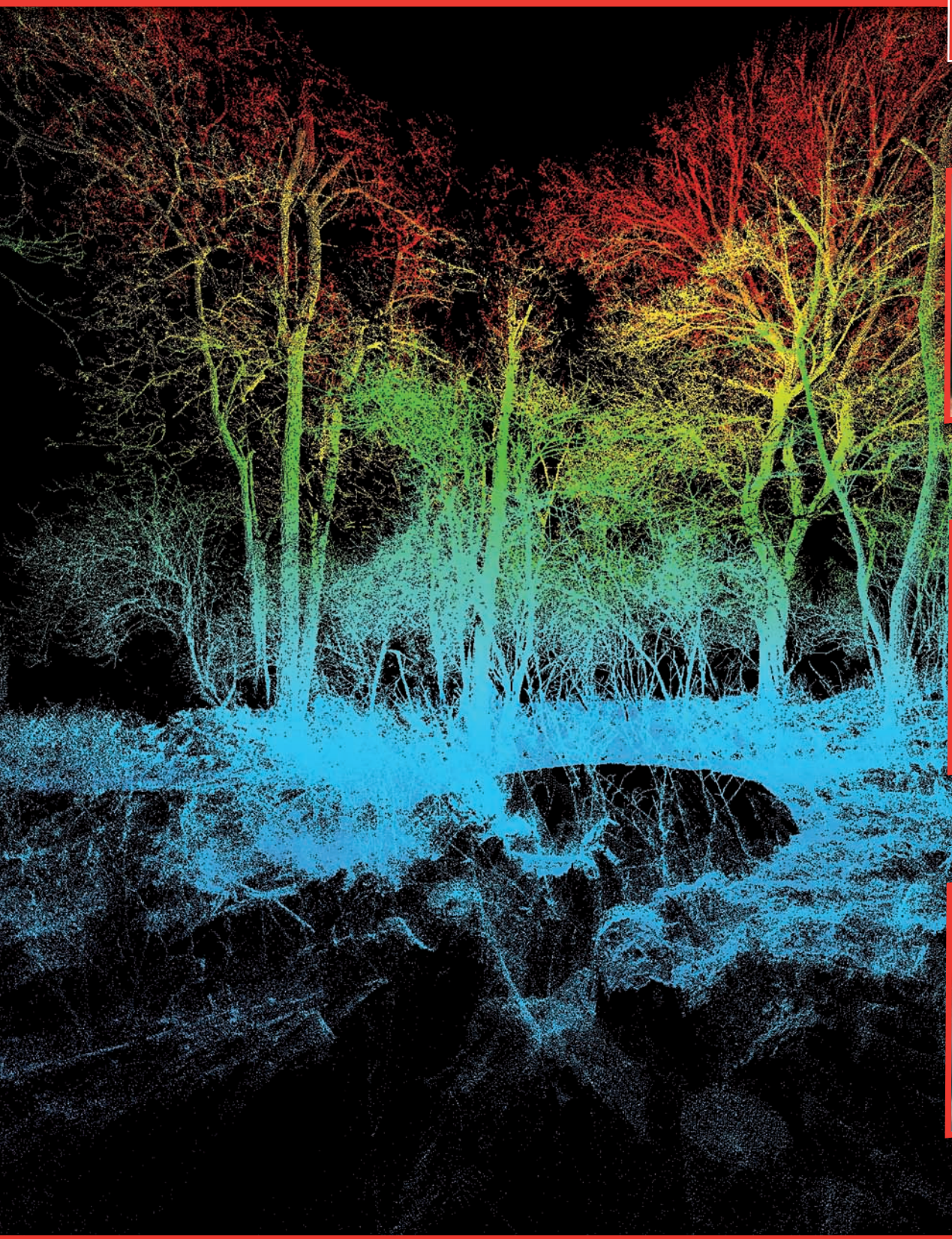
GEO Informatics

Magazine for Surveying, Mapping & GIS Professionals

4
June
2013
Volume 16



- Bentley Pointools V8*i*
- Esri 2013 Developer Summit
- Going for Gold with LiDAR
- Intergraph Geospatial 2013

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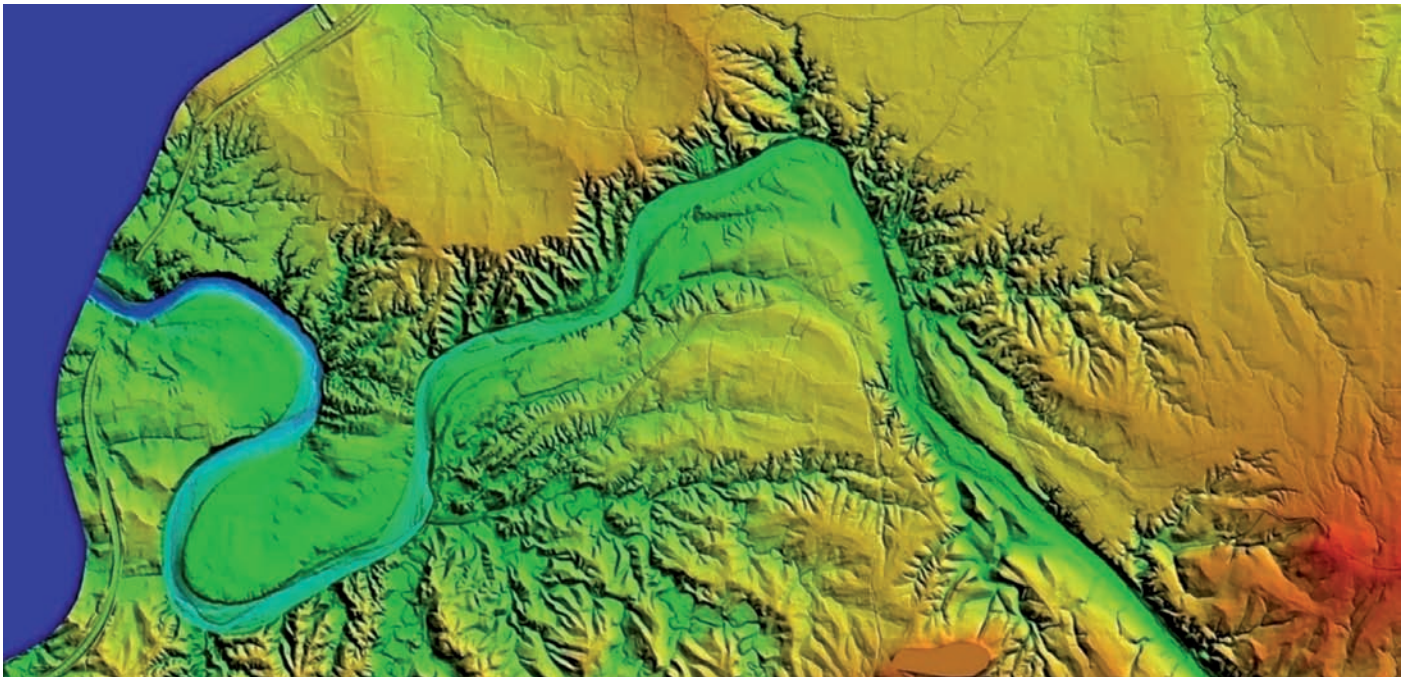
Article

SECON, a GIS driven multidiscipline engineering company, developed a mapping system that was used for rapid generation of accurate base maps with a DTM for planning and designing irrigation projects in India.

Innovative Mapping in India

Using Technological Advances in Geomatics



Digital Terrain Model derived from HRSI

Introduction

With a population of 1.2 billion people and the vagaries of monsoon, India needs to develop its water resources to meet the growing demand for food production and security. The use of technological advances in geomatics for rapid generation of accurate base maps with Digital Terrain Model (DTM), to plan and design irrigation projects, is imperative.

SECON is an Indian, GIS driven multidiscipline engineering company, who developed its own unique system to provide appropriate ground control, DTM and ortho from stereo high resolution satellite images (HRSI), thereby saving substantial ground input. This will serve as a forerunner for the development of further Water Resource projects.

The map, which was generated using this system, was invaluable for demarcating catchment area, locations of interventions, sizing of storages, planning, design of a canal distribution network, structures and evaluation of Land Use/Land Classification.

A base map for 16,000 sq.km was prepared within 18 months. An extensive PILOT test was carried out to confirm the accuracy and suitability of the method of hybrid combination of Ground and 3D (HRSI). The results were found to be satisfactory as a cost and time effective solution. The accuracy derived from this method is a benchmark even for the satellite image provider.

SECON's hybrid method combining High Resolution 3D Stereo Satellite Imagery (HRSI), in the planning and design of 10 Watersheds for the Narmada River in Madhya Pradesh India, for Base Maps on 1:2500, 4000, 10000 scales, proved successful. Longitudinal and cross sections were also developed for optimizing canal corridors and a distribution network.

This method is more cost effective and faster compared to purely Aerial or Ground method in developing countries, where the economics, logistics and security issues for aerial photography/LiDAR are the main constraints.

The project, after completion, will provide water for millions of people and irrigate an area of around 2200 sq. km of fertile land. The base maps prepared by SECON will also be used for the rehabilitation and resettlement of affected people in this project area.

Study Area

The Study area encompasses the 10 Watersheds (sub basins) of the Narmada River in the state of Madhya Pradesh, India. It is the fifth largest river in the Indian subcontinent. It is one of the few rivers in

India that flows from West to East. It flows through the states of Madhya Pradesh, Maharashtra and in Gujarat. The Narmada Valley Development Authority (NVDA) is the Government Agency responsible for the management of the Narmada River and its River Basin. The total length of the river from the head to the outfall into the sea is 1312 km.

Objective

The study was carried out with the following objectives:

- Mapping the area for an extent of 16000 Sq Km.
- Contour map preparation to obtain the contours of 0.50 m intervals so as to plan the medium and minor projects (Micro Water Sheds) in the 10 sub basins/Water Sheds.
- Geo referencing
- Establishing Ground Control Points.
- Digitizing and Editing
- DEM generation.
- Ground Truth validation
- Base Map preparation.
- Screening of the projects.
- Identifying and locating the projects (Location of Dam sites)
- Water Availability Studies, Water Balance, Basin Plan
- Assess Submergence and Command Area for 1300 Sq Km of Cultivable Command Area.
- Size of storage
- Planning and Design of Canal Network and associated structures
- Classification of Land use/Land cover

Data Use

The different types of data used for the project purpose;

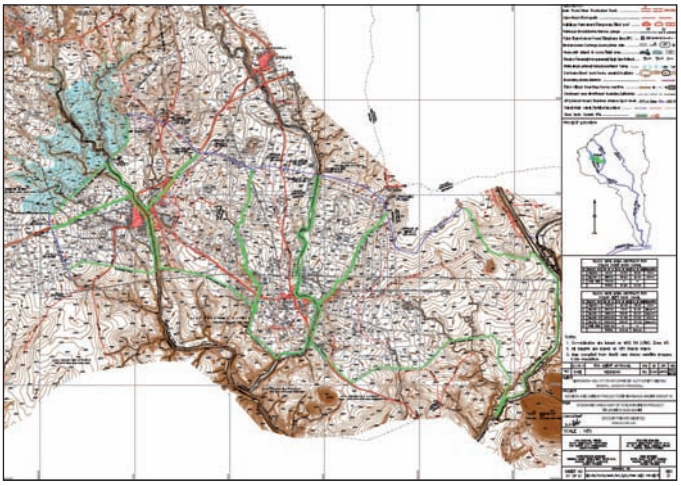
- 0.50 m High resolution, Stereo Satellite Imagery
    - Topographical Maps.
    - Ground data obtained from field survey.

Methodology - Case Study

The basic requirement for Engineering Design, for a project of such magnitude, which must include Water Shed Management, Flood Control Studies and Rain Water harvesting, is the generation of an accurate Base Map. This must have extensive mapping and contours providing the details of 3D Terrain configuration, catchment area, Forest cover, Land use, Utilities, places of inhabitation etc, of sub Basin area.

By the conventional ground survey method, the volume of work to be executed was estimated to require about 100 land surveyors working for 8 to 10 years in undulating and forested terrain on each of the Sub Basins.

There are restrictions and limitations on successfully and rapidly executing Aerial Surveys in India because of security clearance, customs delay, and weather conditions. The High Resolution Stereo Satellite Image (HRSI) Mapping Method combined with ground control and validation was chosen as the fastest and most cost effective technique possible. The option of extracting 3D ground features from HRSI using a combination of suitable software, along with photogrammetric software, was implemented. The stability, speed and the user friendly interface of the software helped to extract the required information accurately from the large Stereo pair Images; each over 2 GB in size. In order to compile data from stereo HRSI, Differential Global Positioning System (DGPS) control was established. It was post pointed and processed to achieve the desired accuracy. Topographic compilation was performed and an automatic DTM was created. The



Map compiled from Stereo HRSI Photogrammetry

DTM was edited to eliminate any spikes or error points. Orthorectified images were generated. Planimetric details were digitized from Orthorectified imagery by on-screen digitization. Contours were generated from the DTM after generation of Triangulated Irregular Network (TIN). All data was merged to create a map on the desired scale with contours at 0.50 m intervals. CAD editing was carried out to create a map as per Cartographic Standards. Suitable software was used as a drafting tool during Photogrammetry compilation and CAD editing.

The output produced by using modern methods was used for further planning for the design of medium and minor projects in the 10 sub basins. This combination of Ground Survey and Planimetric Topo-°graphic compilation in Photogrammetry work station using HRSI has helped the project authority to complete the desired tasks in a shorter time period than that required by conventional Ground Survey alone. Macro level mapping can be developed using Stereo HRSI followed with LiDAR mapping for micro level and more detailed and higher accuracy. Maps are utilized to support Flood Insurance and Flood plain management activities. The maps can also be used for a variety of applications including disaster preparation, response, recovery, risk assessment and diverse mitigation measures.

Conclusion

Modern technology using Stereo High Resolution Satellite Images was very helpful in this project. Remote Sensing and GIS proved to be very comprehensive in the study of large areas like Watershed, Flood plain studies and Rain Water Harvesting, where integrated and simultaneous activities have to be executed. Water preservation will remain incomplete if preventive measures are not undertaken. It is predicted that water scarcity is imminent in the future and this could also lead to conflicts and social unrest.

It would be advisable, therefore, to explore Remote Sensing and GIS techniques and implement them appropriately. Merging conventional methods with modern techniques can be used for all Water Resource projects without compromising on the desired quality. This method is more cost effective and faster compared to purely Aerial or Ground method in developing countries, where the economics, logistics and security issues for Aerial Photography/LiDAR are the main constraints.