

Tapas Martha

Title: Semi-automatic landslide detection by object-oriented analysis using earth observation and elevation data for landslide hazard and risk analysis.

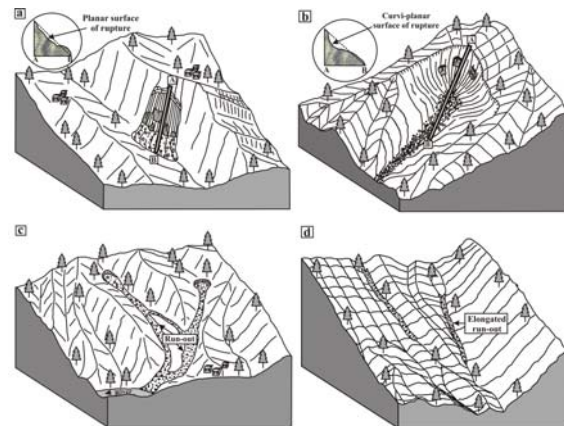
Level: PhD

Description of work:

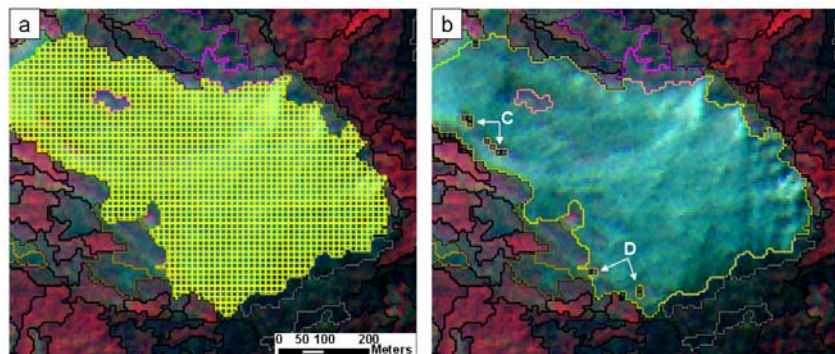
Landslides are a major natural hazard, causing significant damage to properties, lives and engineering projects in all mountainous areas in the world. Recognition and classification of landslides is a critical requirement in pre- and post-disaster hazard analysis. In this project, an algorithm using object-oriented image analysis (OOA) was developed to automatically detect landslides. This method uses rules, similar to a cognitive approach an image interpreter will employ to detect landslides using manual methods. The significant advantage of OOA over other pixel-based methods is the realistic outputs that can be easily verified on the ground. The rule set was developed in Definiens Developer 7 (now eCognition) software environment and requires two primary datasets: high resolution satellite data and a DEM. It also uses some of the second order derivatives calculated from the DEM. The results achieved so far include the detection of five types of landslides with 76.4% accuracy using this algorithm for an area in the Himalayas in India.

In the next phases of this PhD project emphasis is on improving the initial image segmentation, which has traditionally been very subjective

and trail-and-error based. A second component is to explore how the reliance of OOA rules on hard thresholds can be reduced to make those rulesets more robust against small image modifications (e.g. illumination differences) and more transferable to other settings.



Schematic block-diagrams of different landslide types. a) translational rock slide, b) rotational rock slide, c) debris flow, d) shallow translational rock slide.



Resegmentation and merging of objects. a) chessboard segmentation to create small objects to eliminate small patches of vegetation or barren land (C and D in b) within bigger landslide objects. b) classification and removal of smaller patches and subsequent merging of the remaining gridded objects to a single landslide object for application of adjacency condition required for classification of landslides.

Biography: Tapas Ranjan Martha was born on 05th August 1977 in Begunia, Orissa state, India. He worked on his MSc degree in applied geology from 1996 to 1999 at the Indian School of Mines University, Dhanbad, India (www.ismdhanbad.ac.in), and continued there as a researcher from 1999 to 2001. In 2001 he joined the National Remote Sensing Centre (NRSC) of the Indian Space Research Organisation (ISRO), Department of Space, Government of India (www.nrsc.gov.in) in Hyderabad, India as a scientist. Since then his work has mainly focused on image interpretation, including the preparation of thematic layers for several geotechnical, mineral and oil exploration, and geoenvironmental projects. In 2007 he was deputed to ITC from NRSC to carry out advanced research on rapid detection of landslides from Earth Observation (EO) data. He is currently involved in a sandwich PhD program between ITC and NRSC and works on automatic detection of landslides using object-oriented image analysis (OOA).



Publications:

Martha, T.R., Kerle, N., Jetten, V.G., van Westen, C.J. and Vinod Kumar, K. (2009) Characterising spectral, spatial and morphometric properties of landslides for semi-automatic detection using object-oriented methods. *Geomorphology*, in press.

Kumar, K.V., Lakhera, R.C., **Martha, T.R.**, Chatterjee, R.S., Bhattacharya, A. (2008) Analysis of the 2003 Varunawat landslide, Uttarkashi, India using earth observation data. *Environmental Geology* 55, 789-799.

Kumar, K.V., **Martha, T.R.**, Roy, P.S. (2006) Detection of volcanic eruption in barren island using IRS P6 AWiFS data. *Current Science* 91, 752-753.

Kumar, K.V., **Martha, T.R.**, Roy, P.S. (2006) Mapping damage in the Jammu and Kashmir caused by 8 October 2005 M-w 7.3 earthquake from the Cartosat-I and Resourcesat-I imagery. *International Journal of Remote Sensing* 27, 4449-4459.

Martha, T.R., Bhattacharya, A., Kumar, K.V. (2005) Coal-fire detection and monitoring in Raniganj coalfield, India - A remote sensing approach. *Current Science* 88, 21-24.