THE FUTURE OF DISASTER RESPONSE MANAGEMENT

KATHMANDU UNIVERSITY RECENTLY TAUGHT UAV-MAPPING APPLICATIONS FOR EMERGENCY RESPONSE AND DISASTER MANAGEMENT TO HELP WITH THE RECENT EARTHQUAKES IN NEPAL, REPORTS KRISTA MONTGOMERY

In the event of a disaster, such as the earthquakes that struck Nepal this spring, up-to-date maps and models produced from UAV-acquired imagery and photogrammetry software can provide critical information for disaster evaluation and reconstruction. As part of a collaboration with Kathmandu Living Labs (KLL) and Kathmandu University (KU), UAV and photogrammetric technology leaders from around the world came together in September for a week-long UAV training mission: to teach a group of Nepali professionals and students how to use UAVs and image-processing software for a wide range of humanitarian and development purposes.

For decades, satellite imagery has been used in disaster response, but it is not without shortcomings: availability, spatial resolution and a restrictive vertical perspective limit its usability. UAVs, on the other hand, are relatively easy to use and labour- and cost-efficient. When combined with image-processing software, they can be used for frequent surveys of rapidly changing areas, which is crucial in a disaster. UAV imagery also offers a reliable oblique perspective without cloud cover. These advantages and the high resolution outputs generated by photogrammetric software have placed UAVs in the spotlight of the disaster response community.

Patrick Meier, founder of the Humanitarian UAV Network (UAViators), spearheaded the training as part of an inauguration of sorts for Kathmandu Flying Labs, a UAV innovation centre being set up in collaboration with KLL. "Disasters don't wait and time is a luxury that affected communities don't have," says Meier, whose network focuses on the responsible and efficient use of UAVs in disasters. "My vision and my goal here is to have a rapid response, locally driven, UAV team who can be in the air within hours of a disaster."

Learning

UAV manufacturer DJI, photogrammetric software developer Pix4D, and smartphone producer Smartisan partnered for the training, which had 32 participants from organisations including the Nepal Land Management Training Center, the police, ICIMOD, Practical Action Nepal, NSET, KU and KLL.

The first day of the training, participants learned UAV operation guidelines and regulations from UAViators and the Civil Aviation Authority of Nepal (CAAN), as well as how UAV imagery and photogrammetric mapping are being used by professionals in emergency response, surveying, construction and a variety of other industries.

"In the case of Nepal, besides humanitarian purposes, there are ample opportunities (to use UAV tech)," said Mahesh Thapa, training participant and engineer with the Survey Department of Nepal. "We need to let the authorities know that there is this technology and you can use it."

Trainees learned flight operation from DJI, where each student was able to test the Phantom 3 Advanced quadcopter UAVs, taking-off and landing manually. Next, they added the flight planning application Pix4Dmapper Capture to the UAV controller and used the app's automatic take-off, mission, and automatic landing for image acquisition. Back in the classroom, Pix4D explained the basics of photogrammetric UAV-mapping and why image overlap and a proper flight plan are essential for good results in photogrammetric software. Students learned to process images in Pix4Dmapper to produce georeferenced 3D point clouds, mesh models, orthomosaics and digital surface models.

"We want these students and professionals to be instrumental in using and developing this technology to provide a strong disaster preparedness in Nepal," says Olivier Kung, co-founder of Pix4D.

Operational training on the second and third days included work in the village of Panga, which had been badly damaged in the earthquake. After obtaining permission to fly from CAAN, participants mapped the area, using Pix4Dmapper to generate a model and orthomosaic for the community's reconstruction work.

Data acquisition

Once on site in Panga, the team coordinated with the local community disaster management committee (CDMC), a volunteer organisation that works in emergency management.

After the earthquake, "all the village was locked in by collapsed houses," says Janak lal Maharjan, a CDMC volunteer who participated in the emergency response and continues to help with reconstruction. Debris made it difficult for the food and supply trains from Kathmandu to reach the village. If they had had good maps at that time, Maharjan says, they could have been useful in planning routes in and out of the city, for supply lines and to organise search and rescue. Maharjan and other CDMC members requested that the UAV team map Panga during the training and provide them with data to be used in reconstruction.

The town of Panga, southwest of Kathmandu, was badly damaged in the earthquakes of spring 2015 (© Randy Braun)

Trainees and CDMC members use the Capture app to complete an image-capture flight over Panga (© Kike Calvo)

The landscape near Kathmandu University, which is where the week-long UAV training was held (© Randy Braun)

CDMC member explains how to label printed orthomosaic maps to Panga citizens (© Randy Braun)

Because the streets contained debris, powerlines and people, team members climbed to the rooftops of high surrounding buildings to ensure safe flying. Nine small flights were performed using the Capture app and Phantom 3 UAVs, with a combined flight time of 45 minutes, obtaining around 900 images taken at 3.4cm resolution. Flights were kept small because high levels of airwave interference shortened the distance the UAV and controller could be apart without risking a loss of connection for image triggering. Without such interference, the area covered could have been much larger and conducted using fewer flights.

To ensure images were taken properly for mapping, datasets were uploaded to the Capture Cloud service as soon as the UAV landed, to compute a 2D and 3D preview for viewing in a smartphone browser.

Processing

Using Pix4Dmapper on a laptop, images from all the flights were processed together in one project, which took about 70 minutes on an MSI laptop with an i7 quad core processor and GTX 970M GPU. Automatic processing comprises three main steps: the first optimises camera positions and analyses image information, extracting keypoints and matching them across the images. The second builds a 3D point cloud and model. The third generates the DSM and orthomosaic.

Conclusion

The orthomosaic produced was printed on a 2mx3m waterproof banner for the CDMC to share with its community, which immediately used it to categorise buildings, homes, and damage across the village.

"There are hundreds and hundreds of buildings here: some are damaged, some are not. Where do you even start?" asks Patrick Meier. "This is going to really help them (local partners) strategise more effectively on how to better rebuild and where to rebuild first."

While this training had a humanitarian base, the goal was to demonstrate the potential UAVs and image analysis have for positive impact in disasters. Participants, apart from gaining firsthand experience in the field, manifested this potential through their motivation for practical application and knowledge. Their collaboration and innovation will continue to see the applications of UAV imagery and mapping software in disaster response and more.

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