

## NEW INITIATIVE OF UNMANNED AERIAL VEHICLE (UAV) EMERGING TECHNOLOGY APPLICATIONS IN NORTH EAST FOR CAPACITY BUILDING AND OUTREACH ACTIVITIES OF NORTH EASTERN SPACE APPLICATIONS CENTRE

P.L.N. Raju<sup>1\*</sup>, C. Gupta<sup>1</sup>, V. Saikhom<sup>1</sup>, S. Pandit<sup>1</sup>, A. Qadir<sup>1</sup>, P.S. Singh<sup>1</sup>, D. Chutia<sup>1</sup>, B.K. Handique<sup>1</sup>, J. Goswami<sup>1</sup>

<sup>1</sup>North Eastern Space Applications Centre  
Department of Space, Government of India, Umiam-793103 Meghalaya India - director@nesac.gov.in/plnraju@gmail.com

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**KEY WORDS:** Unmanned Aerial Vehicles (UAV), DEM, multirotor etc.

#### ABSTRACT:

Unmanned Aerial Vehicle (UAV) technology is revolutionizing and acting as an alternative for many of remote sensing applications, particularly for very high resolution satellite requirements, considering easy of flying in the areas of persistent cloud cover like North East. According to top market reports, UAV business is growing at very fast rate. It is valued at USD 18.14 Billion in 2017 and is projected to reach USD 52.30 Billion by 2025, at a CAGR of 14.15% from 2018 to 2025.

North Eastern Space Applications Centre, Umiam, Shillong, Meghalaya, which is responsible for promoting space technology tools for governance and development activities; has taken up a lead role in initiating use of Unmanned Aerial Vehicle for large number of applications such as natural resources management, infrastructure development, disaster response and rescue, project monitoring, research and development etc. Capacity building, training and outreach are important activities taken up by NESAC for promoting use of UAV remote sensing at central/state/academic/research institutions and individual level.

As part of capacity building, NESAC has successfully organized two 2 weeks training program for UAV Remote sensing & Applications for the participants all over the country. NESAC has also organised 1 week training programs for officials from State Remote Sensing Centres of North Eastern Region and North Eastern Council. More than 100 participants have been trained from different part of the country. The focus of the training was to include all aspects of UAV Remote Sensing applications. The details of course curriculum are: basic concepts of UAV, building of UAVs, UAV flight simulation, flight planning, UAV data processing, generation of DSM/DTM/Orthomosaic, use of UAV data for different applications in the field of Agriculture, Disaster management, Forestry, Infrastructure planning, construction monitoring etc. Pilot project is also incorporated as part of the training. Apart from training programs at NESAC, large numbers of application projects (> 60 nos.) have been successfully completed. Outreach activities are also carried out which includes exhibiting UAVs at seminars, demonstration to large no. of students, showcasing UAV capabilities at disaster drills carried out by State Disaster Management Authority (SDMA) etc. The new initiatives of UAV convinced all concerned at taking up UAV RS applications for governance and developmental activities. The full paper will discuss all the aspects of UAV technology and applications.

### 1. INTRODUCTION

Unmanned aerial vehicle - UAV popularly known as drone, is an airborne system or an aircraft operated remotely by a human operator or autonomously by an onboard computer. There are two broad classes of UAVs- Fixed wing and Rotary based. The fixed wing UAV can carry bigger sensors as payloads for longer distances with higher endurance and can fly during rough windy conditions. The rotary based UAVs are capable for takeoff and landing vertically, hover and perform agile manoeuvring to maintain a visual on a single target for extended periods of time. The fundamental advantage of UAVs is that they are not burdened with the physiological limitations and economic expenses of human pilots and Scientists can conduct research in much more flexible way (Everaerts J., 2008). UAVs are cheaper, smaller and lighter than manned aerial vehicles. UAV operations are far less expensive than any manned aircraft and far more environmentally friendly (generate less CO<sub>2</sub> and noise). UAV based Remote Sensing (UAV-RS) has enabled the rapid collection of high resolution data over a region of interest and emerged as an efficient tool supplementing satellite based remote sensing. With the fast growing need for highly accurate and detailed observation data required in many applications such as environmental (Martínez-de Dios, J.R., et al., 2006), agricultural (Handique B.K., et al, 2016, Sugiura, R., et al,

2005), wild life monitoring (Vermeulen, C., et al 2013, Jarrod C. H., et al 2016 ) and natural resources monitoring, Unmanned Aerial Vehicles (UAV's) has emerged as an efficient supplement to remote sensing data. Low altitude UAVs has seen significant growth in recent years, as they offer flexibility and rapidity of use and low operational cost. In addition, UAVs can be of great value in observations carried out in an environment that may be harmful or dangerous to an aircrew such as forest fire monitoring, landslides, Floods etc.

The huge amount of data, provided by UAVs, represents a new challenge regarding developments of processing, storage and transmission techniques.

This article focuses on the initiatives of North Eastern Space Applications Centre (NESAC) in the applications of UAV for the management and monitoring of natural resources and disasters and showcased a few recent studies carried out in NESAC along with capacity building and outreach activities of NESAC.

### 2. UAV REMOTE SENSING ACTIVITIES AT NESAC

NESAC has taken up many activities related to UAV remote sensing i.e. UAV system development, UAV surveys, UAV data processing etc. The major activities of NESAC are as discussed below:

\* Corresponding author

## 2.1 UAV system development

NESAC is involved in development of UAV systems both copter type and fixed wing type. NESAC is having 04 UAVs (3 copter type and 1 fixed wing type as shown in Figure 1).



Figure 1(a): Quadcopter



Figure 1(b): Hexacopter



Figure 1(c): Hexacopter



Figure 1(d): Fixed wing

Figure 1: NESAC UAVs

## 2.2 UAV data processing

NESAC is equipped with specialized data processing software for UAV such as pix4D Mapper pro, Agisoft Photo scan pro along with other post processing software e.g. Arcgis, Erdas Imagine, ENVI etc. NESAC is also working on open source softwares such as Open drone map etc

## 2.3 UAV services

NESAC has provided UAV services for user/line departments for various planning and developmental activities. NESAC has conducted more than 60 surveys till the date for different user departments in the field of Agriculture, Forestry, Town Planning, Disaster Management etc.

## 2.4 Technological support to other departments

NESAC has also facilitated all the State Remote Sensing Centres (SRSACs) of NER along with Andhra Pradesh Space Applications Centre (APSAC) for setting up of UAV operation & data processing facilities. NESAC is providing continuous technical support for different government departments across the country. UAV system given to all the SRSACs is shown below (Figure 2).



Figure 2: UAV system provided to all State Remote Sensing Centres of North Eastern Region

## 3. UAV APPLICATIONS AT NESAC

Along with UAV system development NESAC have also completed more than 60 UAV survey projects for various user departments in different fields of applications e.g. Agriculture, Disaster management, Urban planning, Road monitoring and 3D modelling etc. NESAC takes up survey based on request from different user departments such as National Institute of rural development and Panchayati Raj (NIRDP), North Eastern Electric Power Corporation (NEEPCO), North Eastern Council (NEC), Deputy Commissioner Offices etc. and carry out the survey work and provides suitable outcomes e.g. orthomosaic, maps, videos, 3D models, DEM, DTM, Contour maps etc. as per requirements (Figure 3).

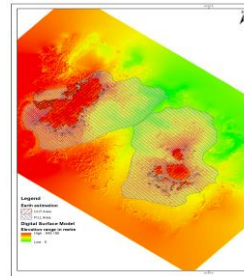


Figure 3(a): DEM generated using UAV data

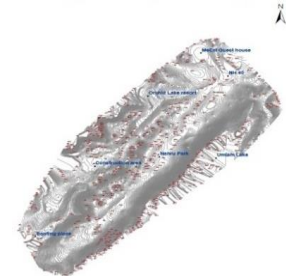


Figure 3(b): Contour map generated using UAV data



Figure 3(c): 3D model generated using UAV data



Figure 3(d): high resolution map generated using UAV data

Figure 3: UAV data products generated as part of different applications at NESAC

## 4. TRAINING AND CAPACITY BUILDING AT NESAC

As part of capacity building NESAC is conducting regular two weeks training on UAV Remote Sensing and Applications along with specific training for the officials from different centres. More than 100 participants had attended the training courses from different part of the country. The major focus of the training was to elaborate the importance of UAVs in Remote Sensing applications. The participants were given lectures on UAV technology and recent advancements, UAV data processing techniques and data analysis for different applications in the field of Agriculture, Disaster management, Forestry, Infrastructure planning, construction monitoring etc. The hands on practical training were also given for UAV data processing. The participants also carried out project works in different themes of UAV applications such as Forestry, Agriculture, Disaster management, urban planning etc. UAV operations and data collection processes were also demonstrated to the participants. NESAC also takes up bachelors/Masters degree students as interns for carrying out their summer/winter projects in UAV Remote Sensing. NESAC also conducted outreach activities which include exhibiting UAVs at seminars, demonstration to large no. of students, showcasing UAV

capabilities at disaster drills carried out by State Disaster Management Authority (SDMA) (Figure 4) etc.



Figure 4: Image captured during disaster drill using UAV

#### 4.1 Two weeks UAV training course at NESAC

NESAC has successfully organized 3<sup>rd</sup> two weeks UAV Remote Sensing (UAV-RS) training course from Sep 04, 2018 to Sep 14, 2018 for the participants from all over the India (Figure 5). The details of the training are as given below in table 1. The following was the topics covered under the course:

- a) UAV system design and integration-Theory
- b) UAV flight simulation-hands on practical
- c) UAV flight planning-Theory & Hands on practical
- d) UAV data processing-generation of Orthomosaic, Digital Elevation Model (DEM), Digital Surface Model (DSM), 3D modelling etc.-Theory & hands on practical.
- e) Mini projects related UAV applications in the field of agriculture, forestry, urban planning, water resources and geology etc.

As per The online feedback the candidates were satisfied with the course and there was a demand to increase the duration of the course up to one month. Some of the feedback results are as shown in Figure 6 .



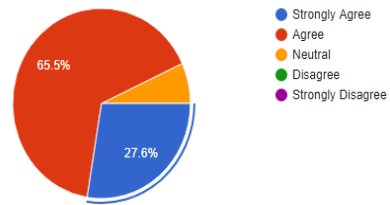
Figure 5: Participants during UAV training at NESAC

Sl. No.	Year	Training dates	No. Of participants
1.	2016	Oct 17-28,2016	29
2.	2017	Nov 06-17, 2017	28
3.	2018	Sep 04-14, 2018	28

Table 1: Details of two weeks training course on UAV Remote Sensing Applications and Technological advancements

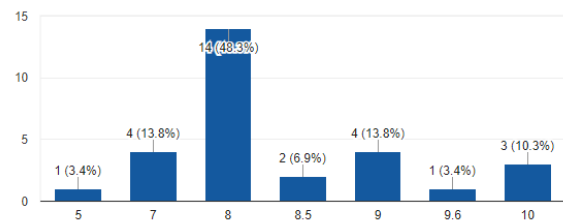
The course met my expectations

29 responses



How do you rate the course overall (on scale of 0-10)

29 responses



What aspects of the course could be improved

29 responses

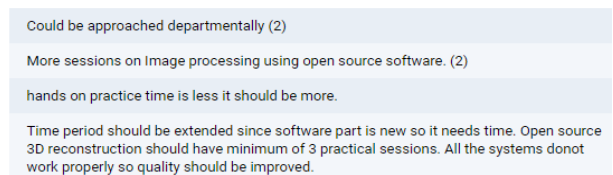


Figure 6: UAV training feedback results

#### 4.2 User specific UAV trainings at NESAC

NESAC has also organised training for officials from different users e.g. North Eastern Council (NEC), All the State Remote Sensing Centres (SRSACs) of as per requirements (Figure 6). The details of the training programs are as given in table 2.



Figure 6: Participants during user specific UAV training at NESAC

Sl. No.	User department	Training dates	No. Of Participants
1.	NEC	Aug 30-Sep 01, 2017 & Sep 25-26, 2017	10
2.	SRSACs	May 08-12, 2017	30

Table 2: User specific UAV trainings at NESAC

### 4.3 Students/interns at NESAC

Apart from above training programs as mentioned in point no. 4.1 & 4.2 NESAC also provides training/internship opportunities to students across the country & abroad. Bachelors/Masters degree students also come to NESAC for carrying out project work from 1 month to 1 year in the field of UAV remote sensing and applications. More than 25 students from different institution/IITs/NITs/Universities have taken up the projects in the field of UAV development and application at NESAC during 2016-2018.

## 5. FUTURE PLANS

Considering the huge demand for the UAV technology NESAC is planning to expand the training and capacity building activities in future. With upcoming new facilities and infrastructure NESAC is planning to increase the no of students per training from 30 to 60. NESAC is also planning to make training modules aligned with DGCA course structure and increase the duration of training up to 3 weeks modular training.

## 6. CONCLUSION

UAV technology is coming up in a big way and there is huge demand for UAV surveys in different fields. To meet those requirements trained and skilled manpower is required. There are lot of carrier opportunities for young graduates in this field. NESAC is providing platform to young graduates for improving their skills in the field of UAV remote sensing.

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