

Proposal for Organizing Two Short-Term Courses on River Discharge Estimation Using Non-Contact Hydrometric Techniques

1. Overview

Acquisition of hydrometric data at river sites is needed for river engineers and hydrologists involved with water resources planning and management to make informed decisions regarding various operational purposes such as flood forecasting, reservoir operations and flood management studies. To circumvent the continuous river discharge measurements at a stream gage, which are costly, tedious and frequently dangerous during flood events, river engineers generally develop stage-discharge relationships (rating curve) using observed stage and the corresponding discharge measurements. Subsequently, rating curves are used to estimate the discharge corresponding to the observed stages. However, the rating curve accuracy being tightly connected to the availability of streamflow measurements for high floods, the same may be affected by high uncertainty if the conventional techniques of flow velocity sampling are used. With the availability of good quality of water becoming a rarity, increasing inter-state disputes on sharing river water becoming a challenging problem, which planning reservoir operations during floods, and for design flood estimation needed for the structures across a river. Therefore, there is a need to monitor river discharge accurately and even during night times. So these requirements necessitate the use of non-contact hydrometric techniques which are emerging and adopted in USA and Europe.

Though water resources in India is state managed, the Central Government is monitoring the inter-state rivers through the Central Water Commission (CWC) and the Central Ground Water Board, which operate under the Ministry of Water Resources. As a part of the hydrometric observation activities, the CWC operates a vast network of more than 900 observation stations on various state and inter-state rivers for the collection of stage, discharge and water quality data. With the implementation of the National Hydrology Project from 2017 onwards, CWC is embarked on the modernization of hydrometric data acquisition of Indian river systems using modern tools such as acoustic Doppler current profilers (ADCP) and stage radars for measuring water levels at select sites. Though the majority of the sites operated by the CWC are still using the traditional current-meter based area-velocity method for computing discharge, a proposal to employ the next generation data acquisition techniques, such as non-contact methods, and an expansion of the hydrometric data collection network at many rivers is in the offing. These methods enable discharge estimation on a continuous basis, including the overnight period and, more importantly during high floods. Apart from the necessity of employing the state-of-the-art hydrometric data acquisition techniques, the vast amount of past recorded stage data at a number of river sites requires the use of suitable analytical tools for converting these data to discharges. Such an approach enables the assessment of water availability at different locations of a river, which is required for many studies, such as assessing the impact of land use and climate change on river discharges.

2. Motivation and scope of the proposed course:

Review of the literature indicates the availability of new hydrometric data acquisition techniques, which have been developed and implemented in various countries. Despite advancements in hydrometry, field discharge measurements in India and other developing countries are still being performed using traditional current meter techniques, which require a vast work force, lack accuracy during high streamflow events, and are unsafe during floods. In addition, flow data of some of the inter-country rivers is not readily available/accessible for planning emergency action measures along the course of these rivers in the Indian territory. Therefore, there is a necessity to identify suitable new hydrometric data acquisition techniques that need to be implemented for Indian river gaging sites, so that these techniques are accurate, reliable, easy to operate and maintain, and cost-effective. With these objectives, it is felt that there is a necessity to organize a short-term course to impart knowledge from theoretical and practical aspects of these techniques. And also, for sharing

the experience of the experts, who have developed and implemented these techniques in the hydrometric practices in their respective countries. This will ultimately benefit the Indian authorities, engineers and hydrologists, who are associated with planning, developing, and implementing water resources projects across many rivers, under the activities of National Hydrology Project. Further, this training programme aims to enhance the proposed stream gage network by identifying suitable site-specific hydrometric methods.

The key objectives of the five-day short-term course are to impart training to the participants for enabling to:

- A. Understand the theoretical background of entropy theory, wave types and routing methods, and the use of satellite and radar products for hydrometric monitoring.
- B. Use of entropy theory for average velocity estimation at a river site based on the measurement of surface flow velocity. Development of simplified stage-hydrograph channel routing methods for discharge estimation and rating curve development. Application of remote sensing techniques for discharge estimation.
- C. Practical application of above techniques using field and satellite data (through lectures and hands-on experiments).

3. Date & Venue

Date: Five-day short-term training courses is proposed to be organized from **3rd to 7th June, 2019**

Venue: Department of Hydrology, Indian Institute of Technology Roorkee

Expected International and Indian experts: Dr. Tommaso Moramarco, Italy, Dr. John Fulton, USGS, USA (Skype), Prof. M. Perumal, Dr. Sumit Sen, Dr. Manoj K. Jain, IIT Roorkee and Dr. Bhabagrahi Sahoo, IIT Kharagpur

4. Additional Information:

About Indian Institute of Technology Roorkee: Indian Institute of Technology Roorkee has its roots in the Roorkee College established in 1847 as the first engineering college in India, which was rechristened as Thomason College of Civil Engineering in 1854 in honor of its mentor James Thomason. After about 100 years of distinguished services, the college was elevated to University of Roorkee on November 25, 1949 as the first Engineering University of the independent India. On September, 2001, the University was converted into an IIT by an act of Parliament of the Government of India. It has now 21 academic departments/centres offering various courses like 12 undergraduate courses in engineering and architecture, 3 dual degree programmes and about 48 postgraduate courses in engineering, architecture, sciences, computer applications and business administration besides research programmes at doctoral level. IIT Roorkee has highly qualified and motivated faculty of about 450 members who are engaged in research and consultancy in addition to teaching. The faculty members offer their expertise through consultancy services to private/public sector agencies as well as to Government agencies. Currently the institute has 4270 undergraduate students, 1690 postgraduates and 1749 research scholars. A number of academic and research centres are engaged in interdisciplinary research, and many collaborative programmes exist with

institutions in India and abroad. several other central facilities exist such as Central Library which has more than 4,00,000 volumes of books and periodicals, Institute Computer Centre, Education Technology Cell with full-fledged television studio, Continuing Education Centre and Institute Instrumentation Centre with highly sophisticated instruments etc. IIT Roorkee is fully residential, with well-designed hostels (Bhawans) both for boys and girls, and family accommodation for married students, sprawling sports ground, a swimming pool, a boat club and a host of students clubs with facilities for different games including tennis, squash, billiards etc.

About Department of Hydrology

The period from 1965 to 1974 witnessed the establishment of a number of International Post Graduate Courses in Hydrology under the UNESCO's International Hydrology Decade. The training and education in Hydrology was one of the main components of this programme. In 1972, with the inception of the International Post-Graduate Course, the Department of Hydrology (DoH) marked its beginning. The courses offered by the Department are presently sponsored by the Government of India and international agencies like UNESCO, World Meteorological Organisation (WMO) etc. Till date, a total of 905 participants including 327 foreign participants from 40 countries have participated in the Post-Graduate Programmes. Since 2003, the Department has widened its horizon by offering admissions to the GATE qualified fresh engineering and science graduates. The Department of Hydrology has been recognized as one of the WMO-Regional Training Centre in 2015.

**Tentative Schedule for a three-day Training-cum-workshop on
River Discharge Estimation Using Non-Contact Hydrometric Techniques**

Day-1: 3rd June, 2019: Monday		
09.30 – 11.00	Inaugural & Tea	
11.00 – 13.00	Current Field Practices of Discharge Measurements in India and Italy (L)	MKJ/TM
13.00 – 14.30	LUNCH	
14.30 – 16.00	Addressing Velocity Measurements during High Floods (L)	TM
16.00 – 16.30	Tea	
16.30 – 17.30	Case Studies	SS
Day-2: 4th June, 2019: Tuesday		
09.30 – 11.00	Flood Wave Types and Channel Routing Techniques I (L)	MP
11.00 – 11.30	Discussion over tea	
11.30 – 13.00	Entropy Theory for Streamflow Measurements (L)	TM
13.00 – 14.30	LUNCH	
14.30 – 15.30	Stage-Discharge Relationships (L)	MKJ
15.30 – 15.45	Discussion over tea	
15.45 – 17.00	Development and Extrapolation of Rating Curves at Gage Sites using Field Data (T)	TM/MKJ
Day-3: 5th June, 2019: Wednesday		
09.30 – 11.00	Flood Wave Types and Channel Routing Techniques II (L)	MP
11.00 – 11.30	Discussion over tea	
11.30 – 13.00	Entropy for Discharge Assessment in Natural Channels without the Bathymetry (L)	TM
13.00 – 14.30	LUNCH	
14.30 – 16.30	Application of Entropy for discharge assessment in natural channels also without bathymetry (T)	TM
16.30 – 17.00	Discussion over tea	
Day-4: 6th June, 2019: Thursday		
09.30 – 11.00	Conventional Velocity-Points Records and Surface Velocity Observations for high flood analyses (L)	TM
11.00 – 11.30	Discussion over tea	
11.30 – 13.00	Approximate discharge estimation techniques only using stage data (L)	MP
13.00 – 14.30	LUNCH	
14.30 – 17.30	Discharge estimation using conventional and non-contact equipment (Practical on field)	TM/MKJ/SS
Day-5: 7th June, 2019: Friday		
09.30 – 11.00	Remote sensing applications for discharge estimation (L)	TM
11.00 – 11.30	Discussion over tea	
11.30 – 13.00	Practical exercise on approximate discharge estimation techniques (T)	MP
13.00 – 14.30	LUNCH	
14.30 – 16.30	Data analysis of discharge estimation (T)	TM/MKJ/SS
16.30 – 17.00	Valedictory	