

**A REPORT ON TEQIP-III INTERNSHIP AT IIT HYDERABAD  
IN  
DISTRIBUTED FLOW ROUTING USING MULTIPLE NUMERICAL METHOD AND  
DIGITAL ELEVATION MODELS (DEMs)**

**INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD(IITH)  
Session: Jun'2019-Jul'2019**

**TITLE OF THE PROJECT  
DISTRIBUTED FLOW ROUTING USING MULTIPLE NUMERICAL  
METHOD AND DIGITAL ELEVATION MODELS(DEMs)**

**UNDER THE GUIDANCE OF**

**ACADEMIC GUIDE:  
Dr. SATISH REGONDA (Assistant Professor)**



**भारतीय प्रौद्योगिकी संस्थान हैदराबाद  
Indian Institute of Technology Hyderabad**

**SUBMITTED BY : MANMEET SINGH  
(3<sup>rd</sup> YEAR CIVIL ENGINEERING)**

**DEPARTMENT OF CIVIL ENGINEERING,  
JORHAT ENGINEERING COLLEGE,  
JORHAT- 785007**

- **INTRODUCTION:**
  - This report emphasizes especially on the application of drone in generating DEMs and performing required flow routing through the obtained DEMs by application of computer program using multiple numerical methods
- **FLOW ROUTING**
  - Flood routing is a technique of determining the flood hydrograph at a section of a river by utilizing the data of flood flow at one or more upstream sections
- **FLOW ROUTING MODEL**
  - **Lumped/Hydrologic routing model:** Flow is calculated as a function of time alone at a particular location. Hydrologic routing methods employ essentially the equation of continuity and flow/storage relationship
  - **Distributed/Hydraulic routing model:** Flow is calculated as a function of space and time throughout the system. Hydraulic methods use continuity and momentum equation alone. Flow is calculated as a function of space and time throughout the system Dominated by continuity and momentum equation
- **NUMERICAL METHODS FOR SOLVING DISTRIBUTED FLOW ROUTING**
  - **Finite Difference method:** For solving P.D.E (partial differential equation) calculations are performed on a grid over the x-t plane. x-t grid is a network of points defined by taking (distance increment  $\Delta x$  and time increment  $\Delta t$ )
  - **Runge-kutta method:** The fourth order runge-kutta method is by far the ODE solving method most often used
- **DIGITAL ELEVATION MODEL**
  - Digital Elevation Model (DEM) is the digital representation of the land surface elevation with respect to any reference datum. DEMs are widely used in hydrologic and geologic analyses, hazard monitoring, natural resources exploration, agricultural management etc. Hydrologic applications of the DEM include groundwater modeling, estimation of the volume of proposed reservoirs, determining landslide probability, flood prone area mapping etc.
- **APPLICATION OF DRONE IN AERIAL SURVEY AND GENERATING DEM**
  - Selection of site for generating DEM
  - Setting up the drone
  - Connecting the drone with device and simultaneously with application
  - Uploading the required mission to be covered by the drone and providing required input settings
  - Importing images to the computer and performing required functions for generating DEM

- **APPLICATION OF PROGRAMMING IN FLOW ROUTING**

The methodology for flow routing using programming includes:-

- Converting raster to point using raster package available in R studio for converting raster to point using `rastertopoint()` function
- Determining the flow direction and flow path using D8 algorithm
- Numerical methods for solution of partial differential equations programmed in R studio for obtaining solution of St. Venant Equation
- Coupling both the program
- Simulating the flow
- **D8-Algorithm:**
  - In this method, the flow direction for each cell is estimated from elevation differences between the given cell and its eight neighboring cells, and hence the name D8 algorithm.
  - In D-8 algorithm, water from each cell is assumed to flow or drain into one of its eight neighboring cells which are towards left, right, up, down, and the four diagonal directions.
  - The flow is assumed to follow the direction towards the cell having the steepest slope.
  - Once the flow direction is identified, numerical values are assigned to the direction.
- **CONCLUSION:**
  - This project taught me the various aspects of Flow routing, Application of drone in aerial survey and Application of R language in flow routing and how to solve the St. Venant Differential equations using numerical methods and this will surely help my cause as a Civil Engineering student and I believe that my natural skills coupled with my dedication and the passion I bring towards achieving my dreams in the field of Engineering will help me become a good Civil Engineer. The internship course structure and the able guidance offered by Dr. Satish Regonda(Project Guide) and the entire seniors will enable me to gain all the required skills and knowledge to enter the world of Engineering with a distinct edge and I am really thankful to them.
- **REFERENCE:**
  - <https://graduatedegrees.online.njit.edu/blog/the-importance-of-flood-routing/>
  - <https://nptel.ac.in/courses/105101002/downloads/module5/lecture1.pdf>
  - <https://nptel.ac.in/courses/105101002>
  - <https://nptel.ac.in/courses/105108077/module7/lecture28.pdf>
  - Applied Hydrology. Ven Te Chow, David R.