

# RAMAN KUMAR

ramank.1137@gmail.com | ramank1137.github.io

## ABOUT

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Research Associate at IIT Delhi with experience applying machine learning and computer vision to remote sensing and medical datasets. Previously spent 5.5 years in industry as an ML Engineer building scalable production systems.

## EDUCATION

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### IIT Delhi

*B.Tech, Computer Science and Engineering*

India

2014

## PUBLICATIONS

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**Kumar, R.**, Dhanakshirur, R. R., Singh, R., Suri, A., Kalra, P. K., & Arora, C. (2025). A deep learning approach for objective evaluation of microscopic neuro-drilling craniotomy skills. *Computers in Biology and Medicine*, 196(Part A), 110650. <https://doi.org/10.1016/j.combiomed.2025.110650> [Github](#)

**Kumar, R.**, Dar, A., Seth, A. (2025). Multi-resolution satellite data processing for contextually relevant land use–land cover mapping: Distinguishing scrublands, farms, and plantations across India. Manuscript in preparation [Github — Methodology](#)

Bansal, C., et al. (2025). Practical methodologies for regionally accurate and relevant land use and land cover classification using Landsat and Sentinel data, under review at ACM Journal on Computing and Sustainable Societies., [Github](#)

## RESEARCH EXPERIENCE

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### Mapping Farms, Scrublands and Plantations using Satellite Data

[Live Application](#) — [Methodology](#)

*ICTD Lab, IIT Delhi*

- Developed a scalable five stage pipeline to map scrublands, farmlands and plantations across pan-India
- S1: Developed a **subset-selection algorithm** using clustered AlphaEarth embeddings and Jensen–Shannon divergence to identify the most representative 3% tiles pan India for generating training samples.
- S2: Used **YOLO** and **FracTAL-ResUNet** architecture with curated and augmented training data to segment representative tiles into farms, plantation and scrublands boundaries at 1.19 m resolution
- S3: Refined these boundaries further using textural (entropy) as well as geometric (size, rectangularity) metrics to obtain high quality samples
- S4: Trained a suite of models on these samples to achieve consistent national-scale separation of the three classes at 10m resolution
- S5: Produced **public pan-India LULC layers** (2017–2018 to 2023-2024) at 10 m resolution; currently preparing a first-author manuscript on this work.
- Notably, the plantation mapping is **first of its kind** effort at Pan-India scale

### Assessing Microscopic Drilling on Ovine Skull and Scapulae

[Paper](#) — [Github](#)

*Graphics and Vision Lab, IIT Delhi*

- Developed a **computer-vision** based system to assess neurosurgical drilling skills for craniotomy procedures.
- Curated a **novel dataset** of drilling procedure on ovine skull and scapulae by collaborating with AIIMS neurosurgeons
- Designed a geometry-constrained training strategy for **Transformer and CNN models** to effectively learn from limited data, achieving accuracy exceeding expert human graders.
- Enabled **real-time evaluation** by integrating our best-performing model with surgical drilling systems at NETS lab.

- Published a **first-author paper** in **Computers in Biology and Medicine (Elsevier)**.
- Contributed to the broader NeuroMentor project, which received the **Prix Galien India Award 2024**.

## Classifying Cropping Intensity across India

[Github](#)

*ICTD Lab, IIT Delhi*

- Developed an **unsupervised learning** approach to classify annual cropping intensity at 10 m resolution using time-series vegetation indices from **multi-temporal optical satellite data**.
- Designed a systematic sampling and validation strategy, collaborating with a grassroots NGO to ensure field-verified accuracy across diverse agricultural regions.
- Manuscript under review at **ACM Journal on Computing and Sustainable Societies**.

## Identifying Ecological Restoration Sites

[Blog](#)

*ICTD Lab, IIT Delhi*

- Developing a methodology to map ecotypes requiring ecological restoration using multi-source satellite data.
- Designed a bottom-up approach that identifies **seed pixels** from reference sites using ecological criteria, followed by **SNIC-based superpixel segmentation** on NDVI time-series to generate coherent ecotype patches.
- Investigating the use of **symbolic regression** to automatically learn restoration rule sets from diverse data layers including LULC, terrain, rainfall, elevation, canopy cover, and land degradation indicators.
- Built an Ecological Restoration Toolkit that highlights high-potential restoration sites to support planners, NGOs, and state-level conservation initiatives.

## Forecasting Forest Fire using Climate and Human variables

[Github](#)

*ICTD Lab, IIT Delhi*

- Curated a 9-year dataset of historical forest-fire clusters across six eastern Indian states using Landsat imagery, by developing a classifier model to classify small and large fire events.
- Modeled forest-fire forecasting using CFSV2 (NCEP Climate Forecast System v2) climate-forecast variables to predict fire occurrence under varying climatic conditions.
- Currently extending the model by incorporating human-related drivers such as settlement density, accessibility, and infrastructure to improve predictive performance.

## Tracking Surgical Tool

[Demonstration](#) — [Github](#)

*Graphics and Vision Lab, IIT Delhi*

- Developed a library to simultaneously capture 6-DoF surgical tool positions and synchronized RGB frames using optical and infrared cameras on the Polaris Vega neurosurgical tracking system.
- Built a **GStreamer-based** pipeline to decode RGB frames from network packets and overlay real-time 2D projections of tool positions onto video streams.
- The system is actively used to collect training data for **SLAM-based** endoscopic tracking in neurosurgical research.

## Visualizing Hampi Virtually

[Demonstration](#)

*Graphics and Vision Lab, IIT Delhi*

- Worked on Digital Walk-Through System to provide virtual tour of Vitthala temple.
- Developed graphical simulation environment of the temple with 3D reconstructions of its damaged parts.
- Worked on Laser Detection System to detect the path of laser pointer inside the temple model

## INDUSTRY EXPERIENCE

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### Euler Systems Inc., Mumbai, IN

Tech Lead

July '18 – Apr '22

#### Complaint Classification System: (Gojek)

- Designed and implemented an end-to-end system to classify customer complaints into 100+ categories, aiding customer service representatives in resolving issues more efficiently.
- Developed an ML pipeline inspired from a paper titled COTA which uses a pointwise ranking algorithm resulting in higher accuracy compared to a standard multi-class classifier.
- Designed and Implemented a [distributed architecture](#) consisting of a training cluster and inference cluster, and a ten stage data pipeline to preprocess incoming data, train, and deploy the model across API serving containers.
- Serialized distributed ML model using mleap to deploy on lightweight API servers, achieving millisecond response time.

#### Data Plan Optimization: (Kore Wireless)

- Developed a product that predicts optimal data plans to decrease data overage and cost for an American SIM card provider
- Developed an heuristic based dynamic bin packing algorithm to find optimal plan
- Saved \$600K per year with optimal predictions

#### Doctor Recommendation System: (Dhani)

- Lead a team to build recommendation system which recommends doctors based on patient's history
- Developed a software to allocate doctors in real-time for video calling from a pool of doctors
- Reduced the waiting time for patients from 65 secs to 12 secs with efficient allocation

#### Backend Development: (Nykaa)

- Implemented e-commerce search, product recommendations and price and inventory management system for Nykaa
- Migrated Nykaa's monolith architecture to microservice architecture

### Ikarus, Gurgaon, IN

Software Engineer

Nov '16 – Jul '18

#### Robotic Process Automation(RPA):

- Worked on Named-entity Recognition(NER) to extract entities like items, prices from unstructured text documents
- Developed an algorithm to detect tables in scanned documents by identifying lines using Hough Transforms
- Worked on auto orientation correction of scanned documents to increase OCR accuracy
- Implemented scalable and distributed data pipeline on pyspark to process millions of documents in batches

## TECHNICAL SKILLS

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| Languages          | Python, Java, C#, C/C++, Scala  |
| Libraries          | PyTorch, Keras, MXNet, Scikit-Learn, NumPy, Pandas, NLTK, Matplotlib, SpaCy, OpenCV |
| GIS                | Google Earth Engine, GDAL, Rasterio, Shapely, QGIS                                  |
| Frameworks & Tools | PySpark, Git, Docker, AWS Lambda, AWS EC2, Elasticsearch, MLeap, Redis, Bash        |

## HOBBIES

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Drumming, hiking and reading fiction

## REFERENCES

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Prof. Aaditeshwar Seth (IIT Delhi)  
Prof. Prem Kalra (IIT Delhi)  
Prof. Ashish Suri(AIIMS, Delhi)  
Sandeep Kadam (CTO, Kissht)