

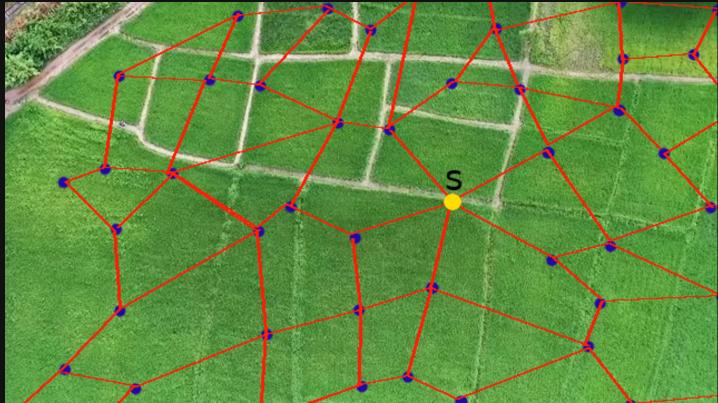
Brief Introduction

B. R. Vinay Kumar

Indian Institute of Technology-Bombay
January, 2025
Mumbai, India

Research Interests

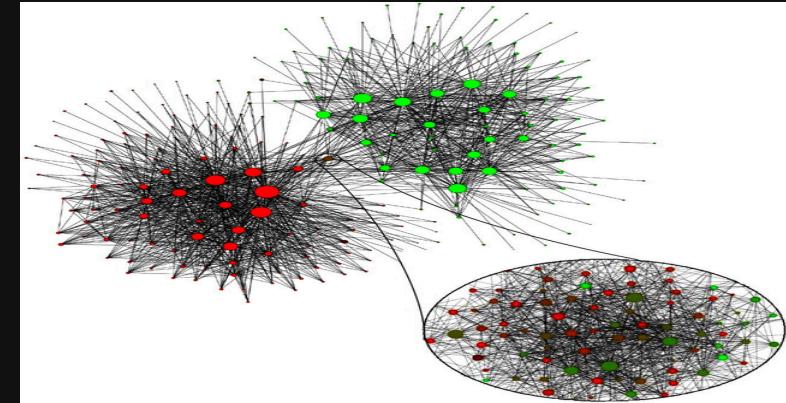
Capture real-world phenomena using ideas from random graphs and network science.



Wireless networks



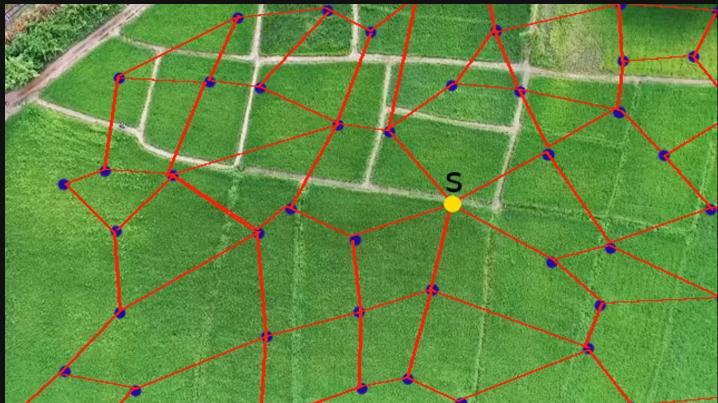
Social networks



Data science

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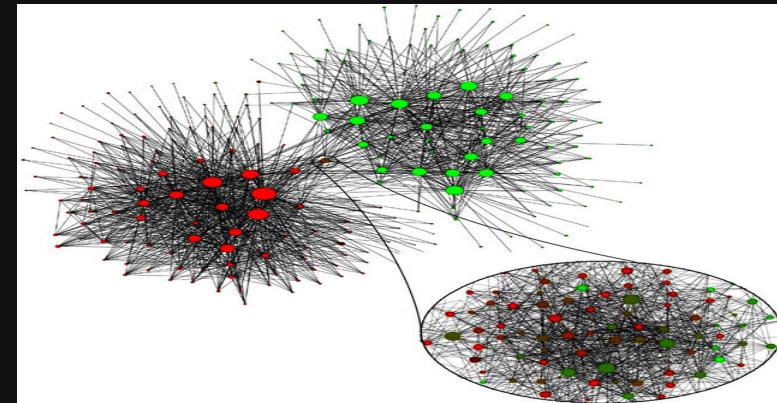
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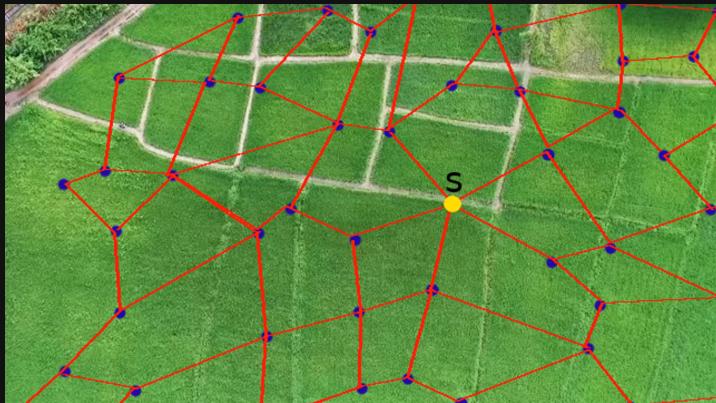


Data science

- **Geometric graphs?** Vertices are embedded in a metric space and edges depend on the distance between nodes.
- Presence of short edges and abundance of triangles.

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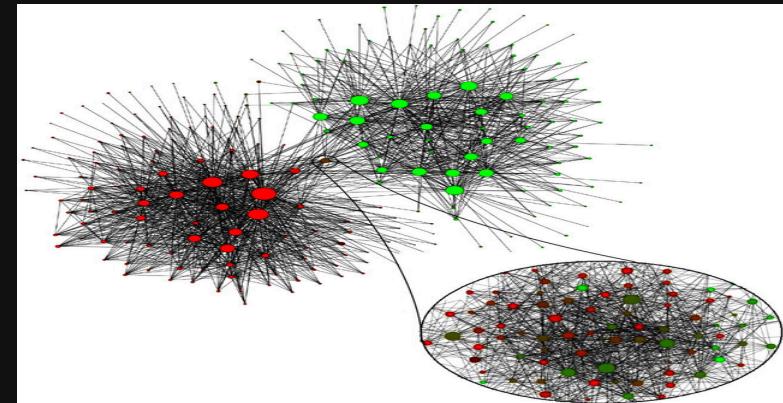
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Questions?

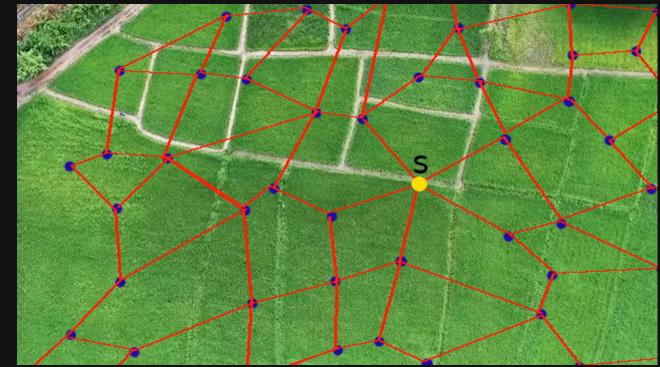
1. How does the network structure affect processes or information on the network?
2. Can local algorithms help to solve a global problem?
3. Does geometry help in solving a global problem efficiently?

Research Profile

Research Profile

1. Probabilistic broadcast with coded packets

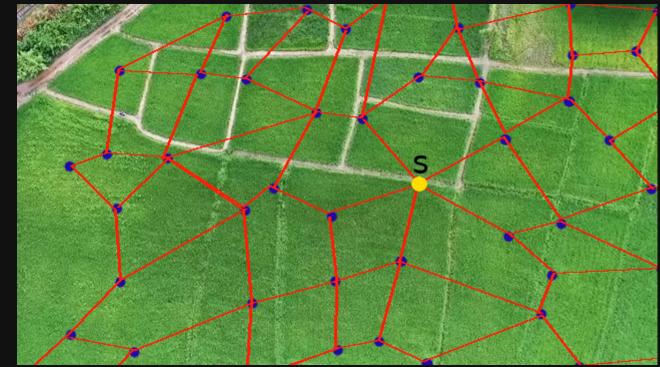
- Proposed and analysed a probabilistic forwarding mechanism with coded packets.
- Counterintuitive result: Using additional coded packets can reduce energy consumption.



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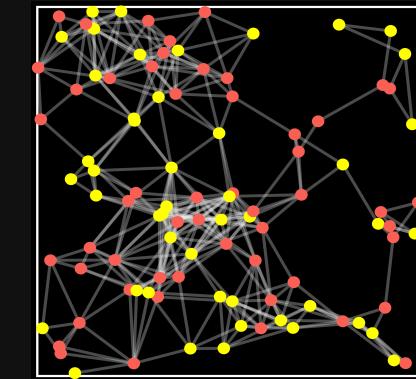
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2. Community detection on geometric graphs

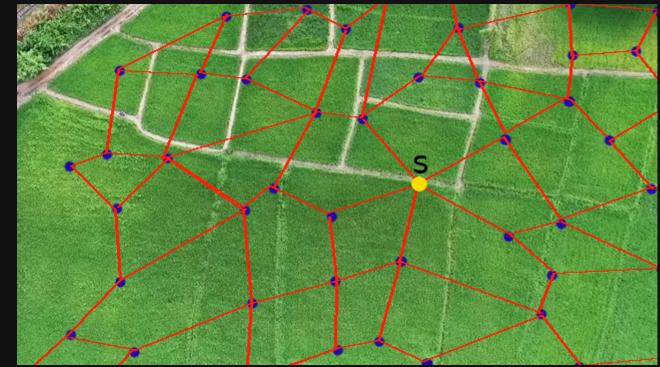
- Conditions when no algorithm can recover the communities.
- Linear-time local algorithm for community recovery.



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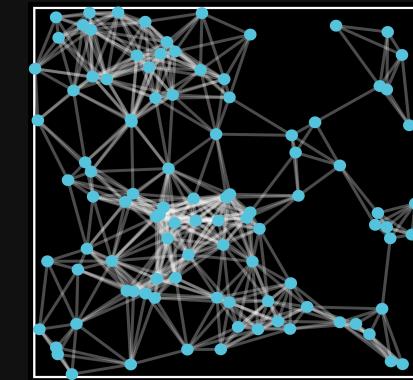
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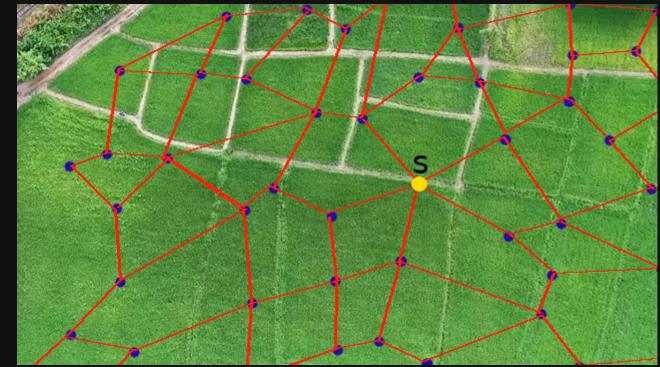
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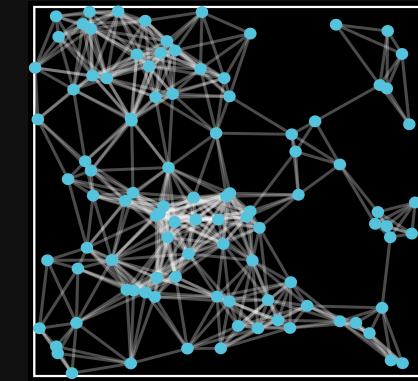


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3. Community detection on hypergraphs

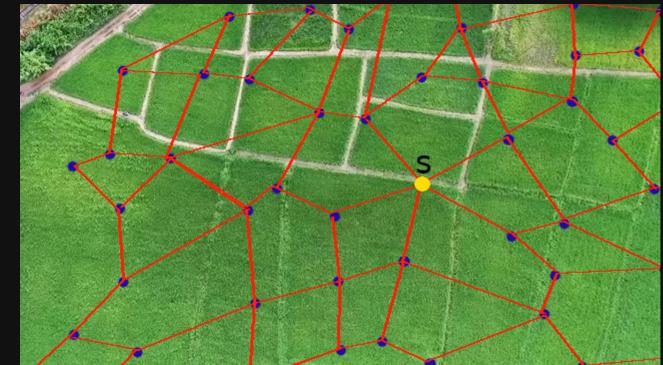
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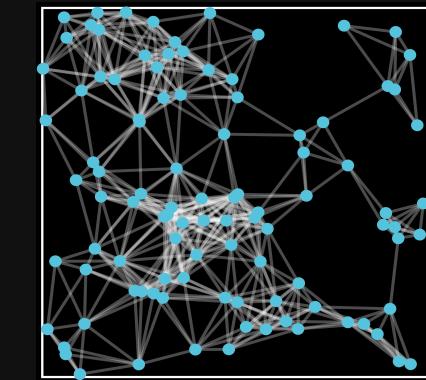
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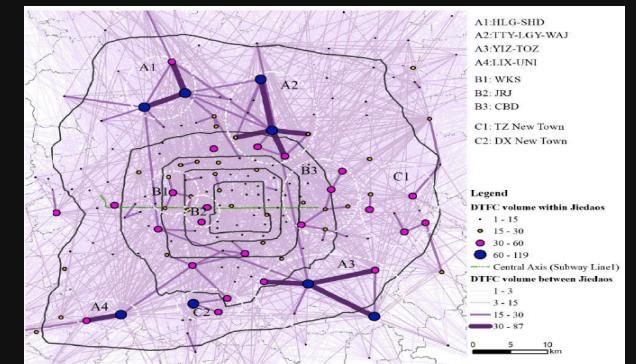


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4. Spatial queues

- Analysed nearest neighbour dynamics in a queueing setting.
- Characterized the fraction of overloaded servers for queues that are spatially distributed.



List of Publications

Preprint

- K. Avrachenkov, B. R. Vinay Kumar, and L. Leskelä, "*Community Detection on Block Models with Geometric Kernels*", Online: <https://arxiv.org/abs/2403.02802>.

Journal

- B. R. Vinay Kumar and L. Leskelä, "*Spatial Queues with Nearest Neighbour Shifts*", *Performance Evaluation*, p.102448, Oct 2024.
- B. R. Vinay Kumar, N. Kashyap and D. Yogeshwaran, "*An Analysis of Probabilistic Forwarding of Coded Packets on Random Geometric Graphs*", *Performance Evaluation*, p.102343, Feb 2023.
- B. R. Vinay Kumar and N. Kashyap, "*Probabilistic Forwarding of Coded Packets on Networks*", *IEEE/ACM Transactions on Networking*, vol. 29, no. 1, pp. 234 - 247, 2021.

Conference proceedings

- B. R. Vinay Kumar, "*Spatial Queues with Nearest Neighbour Shifts*", in Proc. *International Teletraffic Congress (ITC 35)*, Turin, Oct 3-5, 2023.
- K. Alaluusua, K. Avrachenkov, B. R. Vinay Kumar, and L. Leskelä, "*Multilayer Hypergraph Clustering using the Aggregate Similarity Matrix*", *18th Workshop on Algorithms and Models for the Web Graph (WAW 2023)*, Toronto, May 23-26, 2023.
- B. R. Vinay Kumar, N. Kashyap, D. Yogeshwaran, "*An Analysis of Probabilistic Forwarding of Coded Packets on Random Geometric Graphs*", in Proc. *19th International Symposium on Modeling and Optimization in Mobile, Ad hoc, and Wireless Networks (WiOpt 2021)*, Oct 8-11, 2021.
- B. R. Vinay Kumar, N. Kashyap, "*Probabilistic Forwarding of Coded Packets on Networks*", in Proc. *IEEE International Symposium on Information Theory (ISIT 2019)*, Paris, Jul 7-12, 2019.
- B. R. Vinay Kumar, R. Antony and N. Kashyap, "*The Effect of Introducing Redundancy in a Probabilistic Forwarding Protocol*", in Proc. *2018 National Conference on Communications (NCC 2018)*, IIT-Hyderabad, Feb 25-28, 2018.

Research Interests

- Community detection
 - Geometric graphs
 - Inhomogeneous graphs
 - Hypergraphs
- Spatial queues
 - Load balancing
 - Spatial distribution of overloaded servers

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- Teaching assistant / Instructor
 1. Error Correcting Codes - Dept. of ECE @ IISc
 2. Probability Models - Dept. of Mathematics @ IISc
 3. Probability and Statistics for Computer Science - Dept. of M&CS @TU/e
 4. Probability and Statistics for Mechanical Engineers - Dept. of M&CS @TU/e
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- Teaching methodology: explanatory videos, online workbooks, competency based grading

Thank you.