Slime Mold Inspired Algorithm

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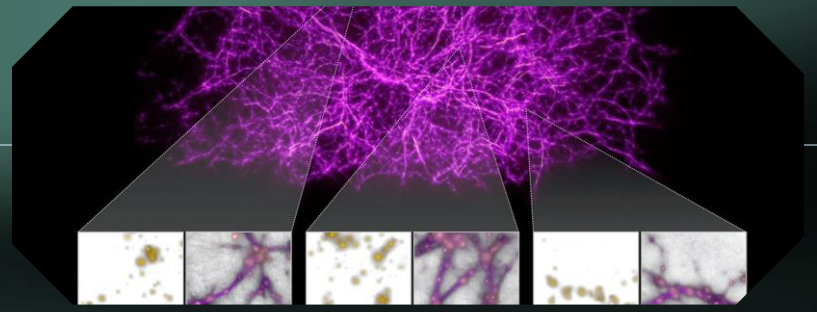
WHAT IS A SLIME MOLD?

BIO phenom

Engineering Application

Urban Planning

The slime mold algorithm is used in urban planning to design efficient transportation and utility networks by mimicking how slime mold finds shortest paths between food sources.
It helps planners optimize road layouts, evacuation routes, and infrastructure connectivity while minimizing cost, distance, and congestion.



Space Exploration

The slime mold algorithm is applied in space exploration to optimize path planning for rovers and spacecraft by finding efficient routes through complex terrains or gravitational fields.
It also aids in designing resilient communication and supply networks for planetary bases while minimizing energy and resource usag

Case Study 1: SMA used in Wuhan Hospital Network

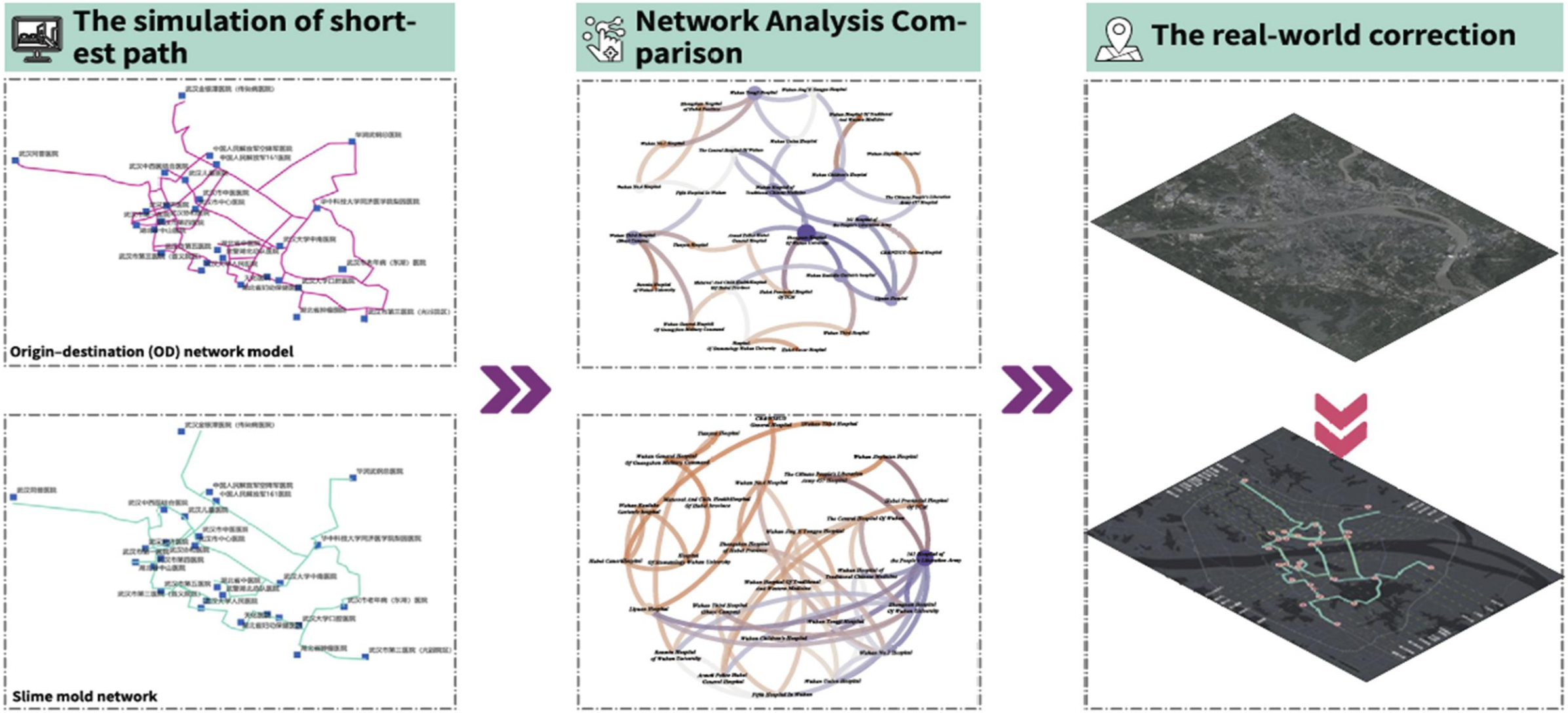
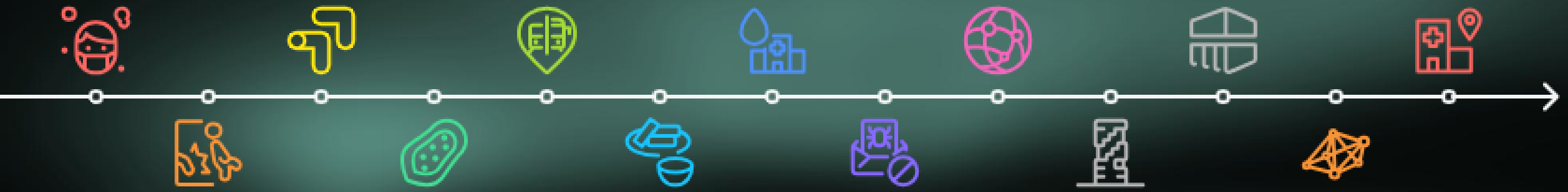


Fig. 4. Overall study of technical framework.

Slime Mold Network Design for Wuhan



Problem Context
Wuhan faces urgent transport needs during COVID-19

Objective
Design emergency life channels connecting hospitals

Optimization Challenge
Balance redundancy and efficiency in network design

Biological Simulation
Use slime mold to simulate network growth

Mapping the City
Represent Wuhan's geography on a culture plate

Nutrient Sources
Place rice cake pieces at hospital locations

Start Point
Introduce slime mold at Zhongnan Hospital

Comparative Algorithm
Compare biological results with computer algorithms

Superior Global Optimization
Slime mold network shows better connectivity

Enhanced Robustness
Slime mold network is more fault-tolerant

Identification of Critical Arteries
Slime mold paths align with real-world infrastructure

Node Centrality and Polarization
Identify core nodes and isolated regions

Strategic Planning Proposals
Propose new hospital locations to improve resilience

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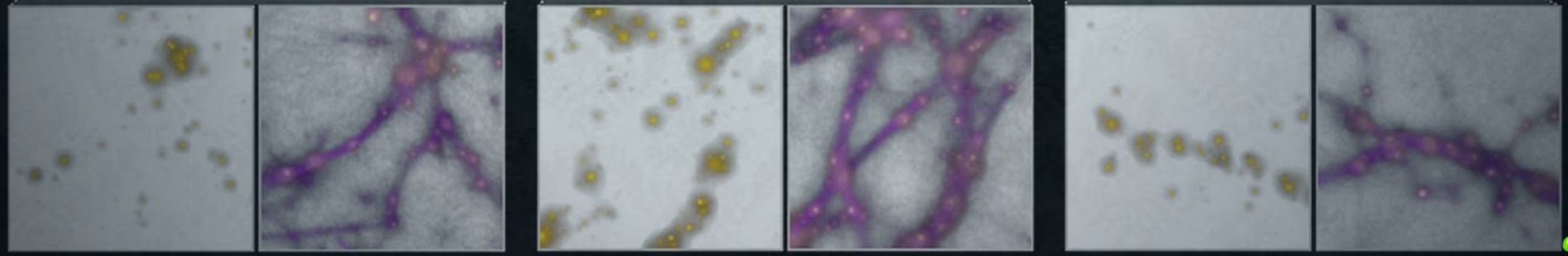
Comparative Network Topology Analysis of Slime Mold and OD Transportation Networks

Fig. 10. Comparative analysis of networks, A: The degree distribution of networks, B: The average clustering coefficient of networks, C: The average path length of networks.

Case Study 2: SMA used in Space Exploration



Background: Dark Matter in the Universe

Dark matter constitutes 85% of the universe's matter and is detected indirectly.

Biological Inspiration: Slime Mold

Slime mold forms efficient transport networks with self-organizing properties.

Slime Mold-Inspired Algorithm

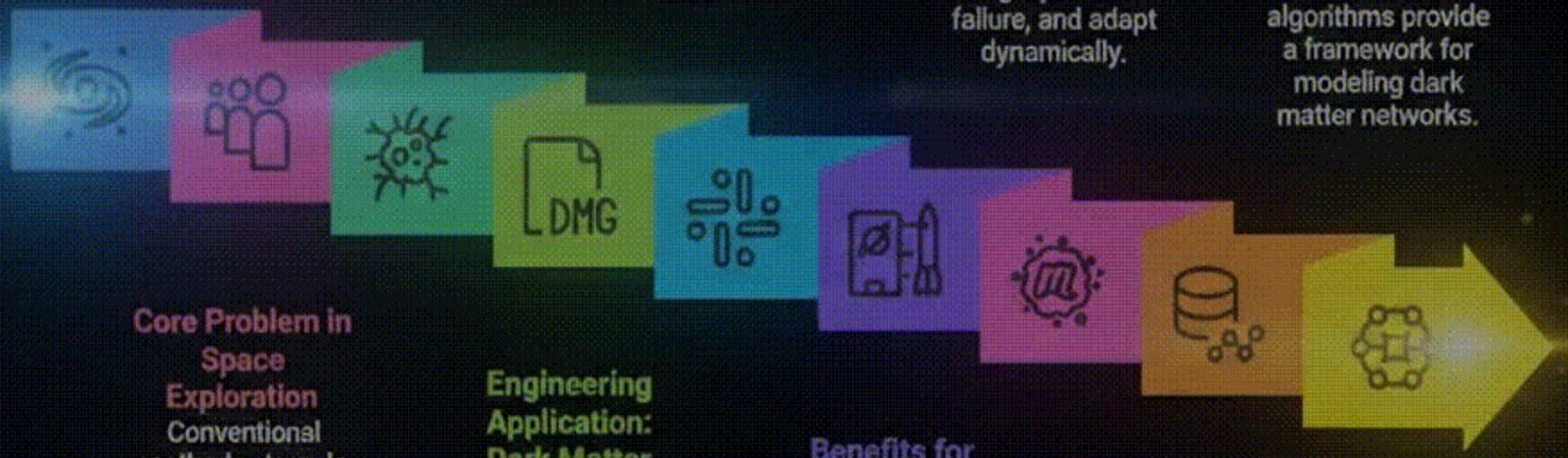
The algorithm reinforces high-density paths and suppresses weak connections.

Why Slime Mold Algorithms Work

They produce filamentary networks, avoid single points of failure, and adapt dynamically.

Key Takeaway

Slime mold algorithms provide a framework for modeling dark matter networks.



Core Problem in Space Exploration

Conventional methods struggle to map dark matter filaments and handle noisy data.

Engineering Application: Dark Matter Filament Reconstruction

Galexy clusters are treated as nodes, and gravitational influence as edges.

Benefits for Space Exploration

The algorithm improves mapping of cosmic structures and planning for missions.

Future Scope

Integration with apace telescope data and enhanced navigation models.

Research Timeline

STATISTICAL DATA

Metric	OD Network	Slime Mold Network	% Improvement
Average Shortest Path Length	3.58	3.02	↓ 15.6%
Network Diameter (Max Shortest Path)	9.0	7.2	↓ 20.0%
Average Degree (connections per node)	2.31	2.89	↑ 25.1%
Average Clustering Coefficient	0.41	0.63	↑ 53.7%
Global Transmission Efficiency	0.112	0.148	↑ 32.1%

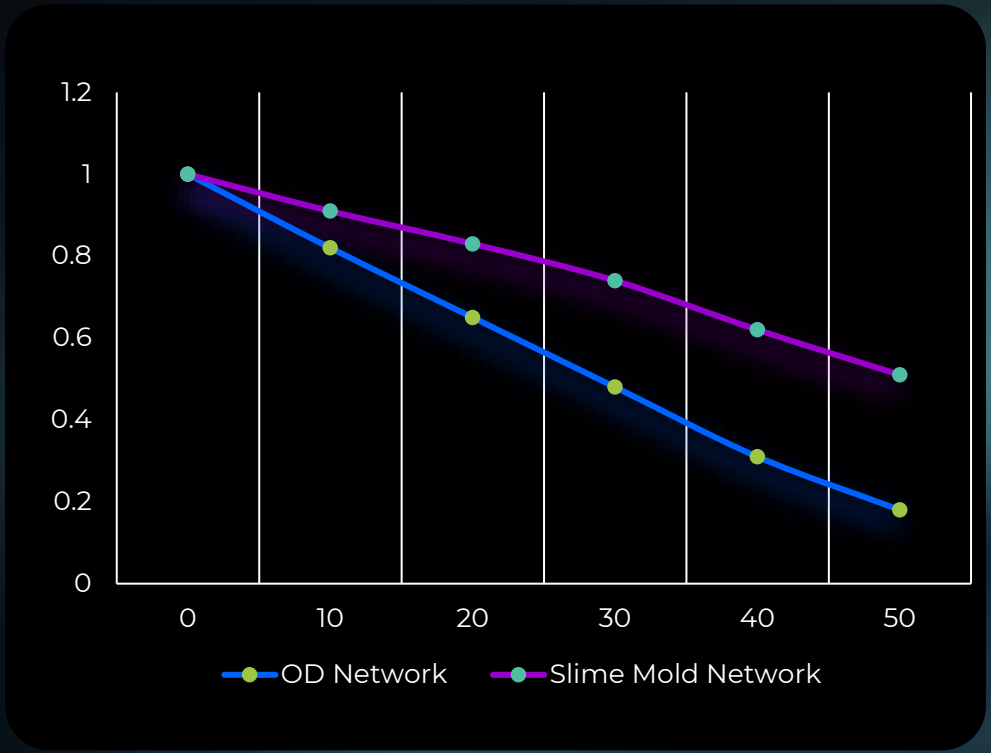
🏹 *Interpretation:*

- Lower path length & diameter → faster emergency transport
- Higher degree & clustering → better redundancy and robustness

Node Removal (%)	OD Network	Slime Mold Network	Meaning
0%	1.00	1.00	Full network, no failure
10%	0.82	0.91	Minor failures, slime mold reroutes better
20%	0.65	0.83	OD starts fragmenting
30%	0.48	0.74	Slime mold still functional
40%	0.31	0.62	OD nearly collapsed
50%	0.18	0.51	Slime mold retains alternate paths

Statistical Data

CHARTS



PROS

1. Global Optimization Ability
2. High Robustness & Fault Tolerance
3. Adaptive & Self-Organizing
4. Efficient Resource Distribution

CONS

PROS

CONS

1. Higher Computational Cost
2. Parameter Sensitivity
3. No Guaranteed Optimal Solution
4. Implementation Complexity