A Multi-Attribute Graph based Handover Scheme for LEO Satellite Communication Networks

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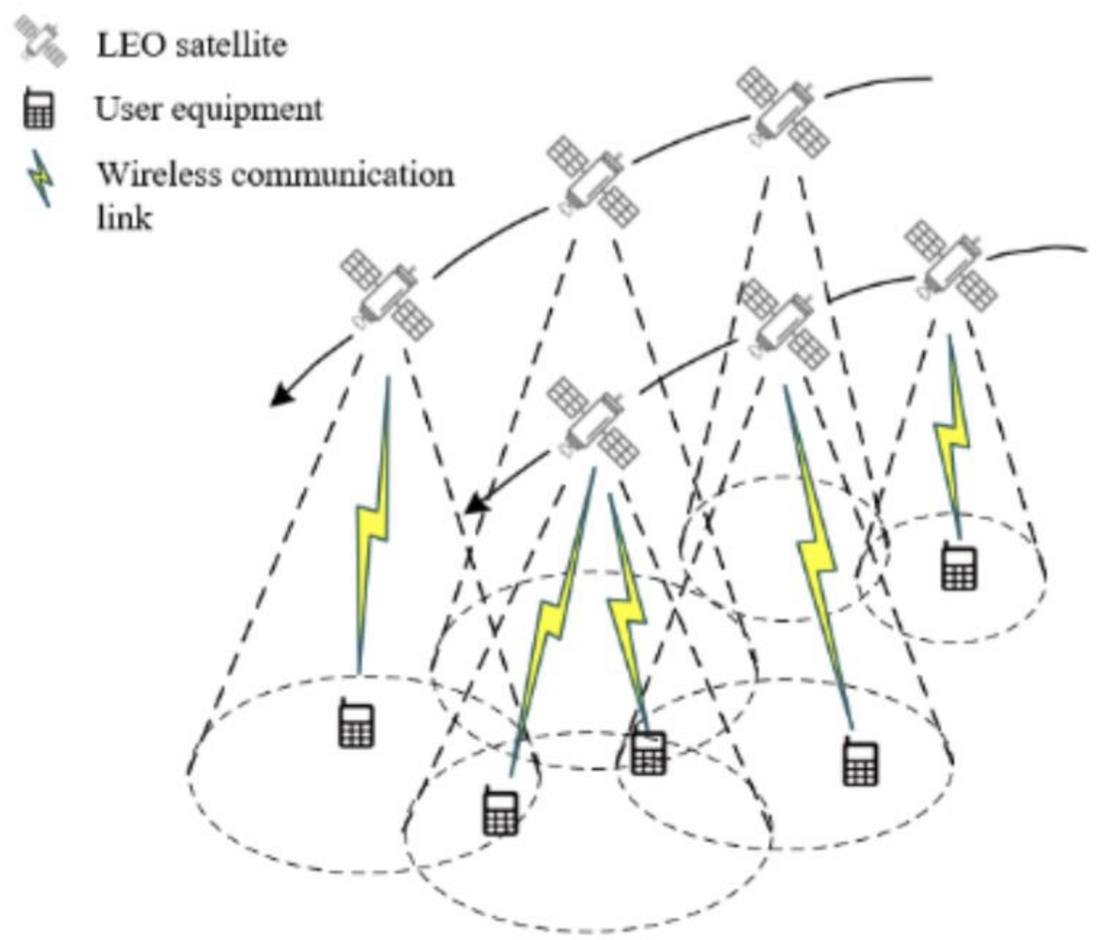
In this work, we proposed an intelligent handover scheme with multi-attribute graph (MAG) and genetic algorithm to determine the handover scheme. Using the critic method, we weighted each target and transformed it into an optimization problem with a single objective since traditional methods cannot achieve all of the objectives simultaneously. Then the optimal handover path can be selected by genetic algorithm. The simulation results show that our handover scheme reduces communication delay and handover time.

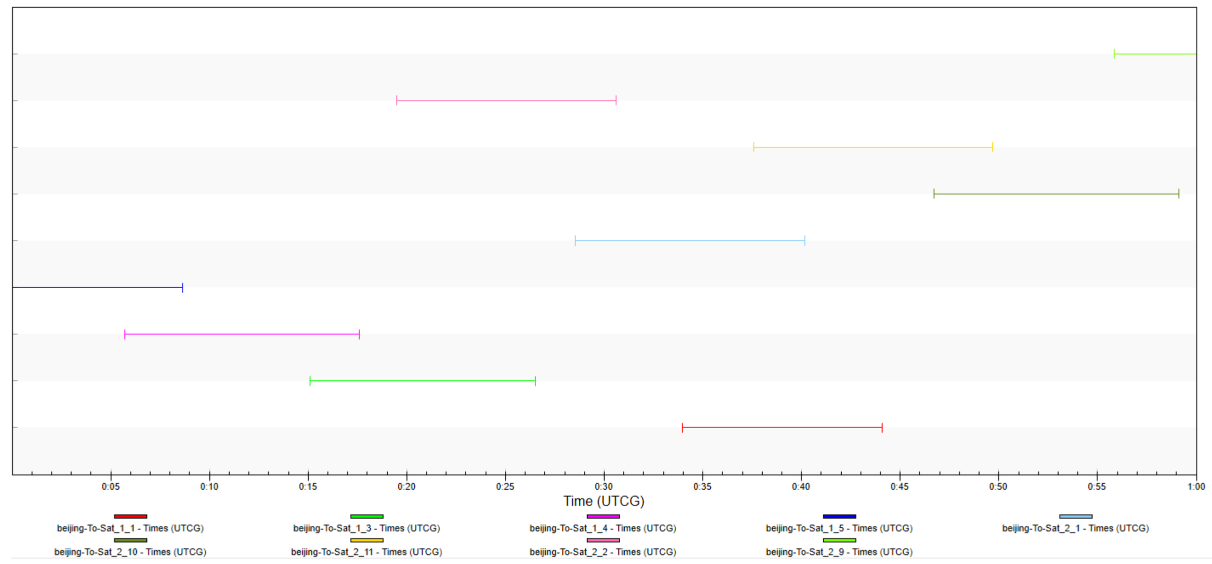
SYSTEM MODEL

Terrestrial users can connect to the covered satellites. At the same time, a user can be covered by multiple satellites, and the communication time of the user may be longer than the coverage time of the satellite, so finding a reasonable satellite handover order to maintain the network quality within the user's communication time is the focus of this paper.

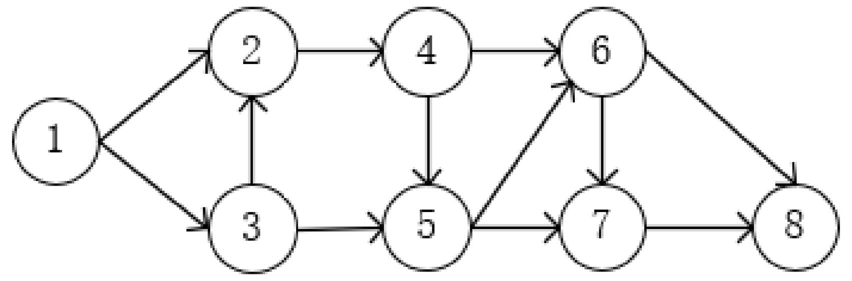


PROPOSED METHOD

We built a joint handover prediction model based on the GBH framework in this study. Firstly, the elevation angle and remaining service time are derived based on the LEO satellite network model to construct a MAG. Afterwards, the handover decision is formulated as finding an optimal path from the MAG. We used the critic method to transform the original problem into a single objective one, then the genetic algorithm was used to solve the satellite handover problem.



Users can treat each satellite coverage as a node, and the user's handover from one satellite to another as a directed edge, and then the user can transform the handover process throughout the communication time into finding a shortest path within the directed graph.

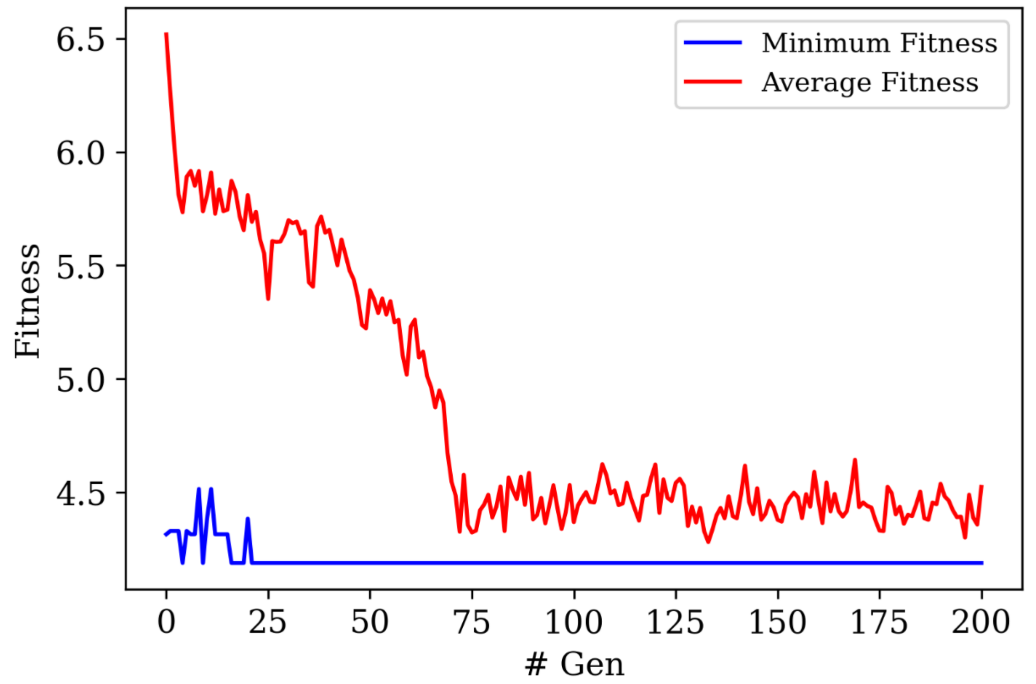


SIMULATION AND RESULTS

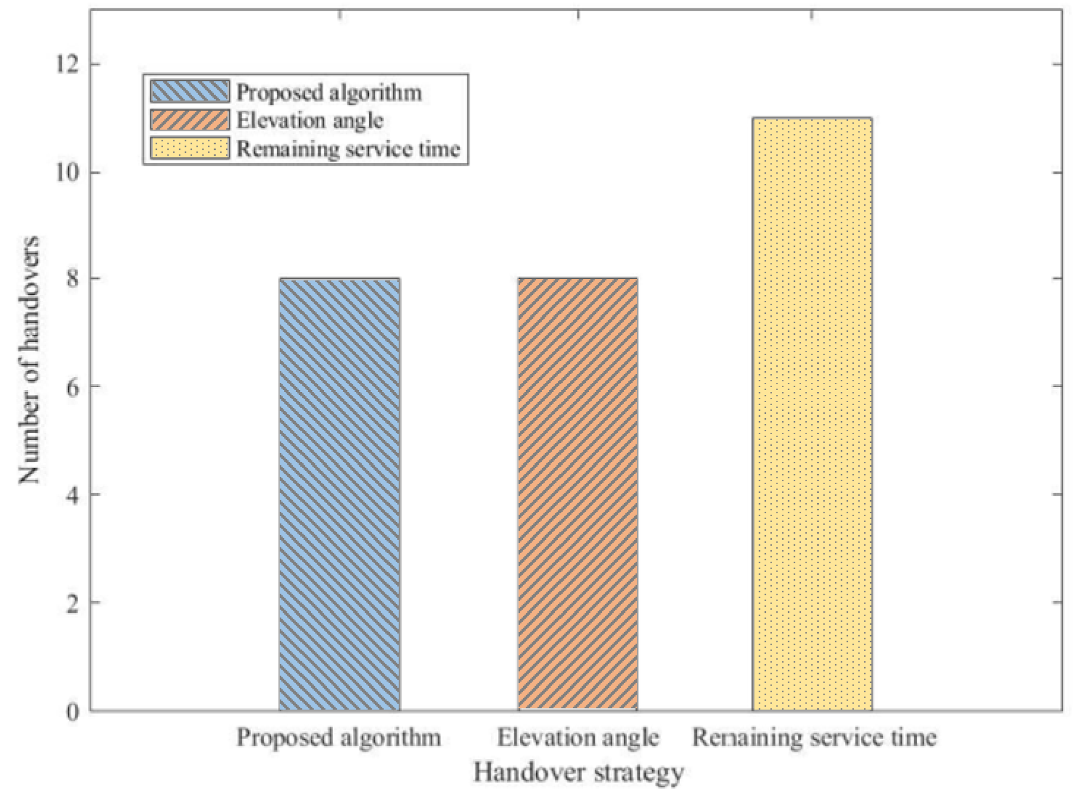
Select a walker constellation for simulation.

Parameters	Simulation Value
Number of satellite	66
Satellie altitude(km)	780
Orbital inclination	84.6°
The number of tracks	6
Constellation type	*Polar orbit*

In the genetic algorithm, the degree of individual fitness is measured by the size of individual fitness, so as to determine the size of their genetic opportunities. In this problem, the genetic algorithm adds the sum of the obtained path lengths as an evaluation function.

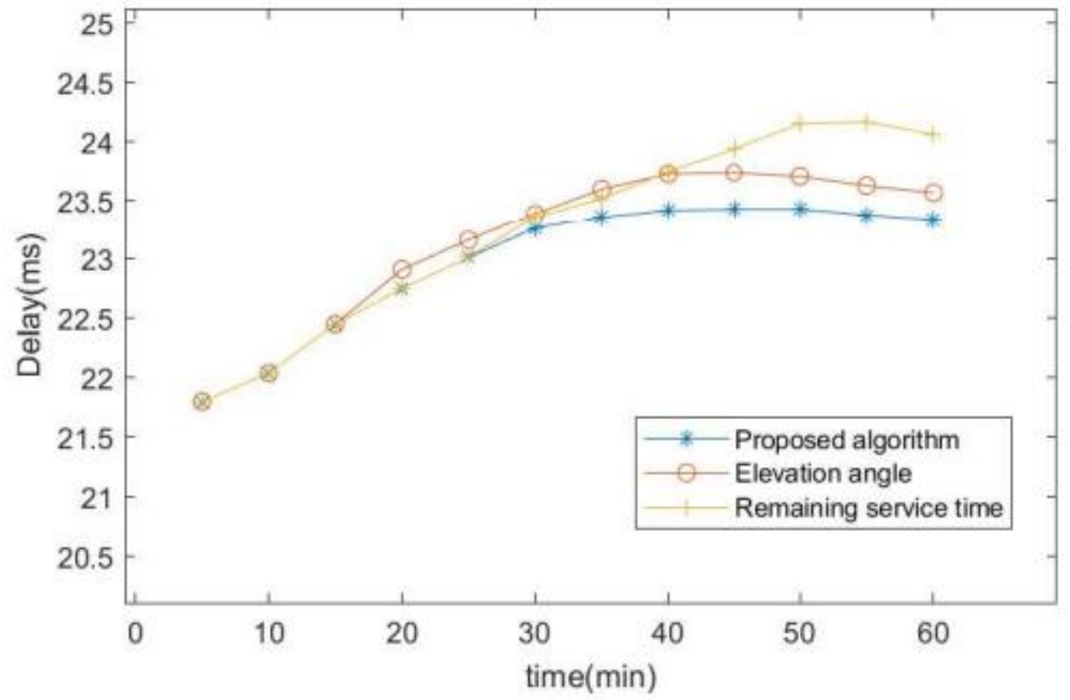


the proposed algorithm has certain advantages in terms of latency. Single-attribute strategy can only consider a single variable, while multi-attribute strategy balance elevation angles with remaining service time for a comprehensive handover strategy.



at the same communication time, the algorithm based on the maximum elevation angle will bring more handover times, resulting in unstable communication for a long time.

Proposed algorithm is able to achieve the same number of handovers as the maximum service time while maintaining low latency. At the same time, graph-based handover can make the handover choice not limited to a certain moment, but pay attention to the entire communication time, so it has a greater delay advantage in the long-term communication process.



CONCLUSION

In this paper, we have investigated the handover problem in LEO satellite communication networks. In concrete terms, aiming to achieve the best selection of networks during handover, the handover decision is formulated as finding an optimal path from the MAG. Then proposed algorithm has been designed to simultaneously maximize the remaining service time and minimize the communication delay while meeting the handover times requirement. Results of simulations indicate that the proposed scheme is capable of obtaining optimal solutions and achieving outstanding network performance. In the meantime, considering the insufficient results caused by limited time, we should reconsider resource allocation after handover in follow-up research, and we should consider introducing more efficient algorithms to solve practical problems in the future, such as machine learning.