"PERFORMING AND PROLONG THE UAV's ENDURANCE USING EFFICIENT MECHANISM"

M. Helan Jancy Reeno [1], Mr. G. Paranthaman M.E (Ph.D.) [2], Mrs. C.G Joy Merline M.E (Ph.D.)[3]

PG Student, Electronics and Communication, Madha Engineering College, Kundrathur, India [1].
Associate Professor, Electronics and Communication, Madha Engineering College, Kundrathur, India [2].
Assistant Professor, Electronics and Communication, Madha Engineering College, Kundrathur, India [3].

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Abstract:
The problem of wireless service provisioning through a rotary wing UAV which can serve as an aerial base station (BS) to communicate with multiple ground terminals (GTs) in a boost demand area. Our objective is to optimize the UAV control for maximizing the UAV's energy efficiency, in which both aerodynamic energy and communication energy are considered while ensuring the communication requirements for each GT and backhaul link between the UAV and the terrestrial BS. The mobility of the UAV and GTs lead to time varying channel conditions that make the environment dynamic. A nonconvex optimization for controlling the UAV considering the practical angle dependent Rician fading channels between the UAV and GTs, and between the UAV and the terrestrial BS.

Traditional optimization approaches are not able to handle the dynamic environment and high complexity of the problem in real-time. To use a deep reinforcement learning-based approach namely Deep Deterministic Policy Gradient (DDPG) to solve the formulated nonconvex problem of UAV control with continuous action space that takes into account the real time of the environment including time-varying UAV ground channel conditions, available onboard energy of the UAV, and the communication requirement of the GTs.

However, the DDPG method may not achieve good performance in such an unstable environment and will face a large number of hyper parameters. To use the Trust Region Policy Optimization (TRPO) method that can improve the performance of the UAV compared to the DDPG method in such a dynamic environment.

KEYWORDS: UAV, NS2, DDPG, TRPO

I. INTRODUCTION

The development of unmanned aerial vehicles (UAVs) technology is emerging to enable 5G systems providing reliable and ubiquitous connectivity to mobile users. In particular, UAVs equipped with onboard wireless transceiver can fly over a target area and provide communication services especially in the areas that are difficult to deploy terrestrial base stations (BSs) or the communication infrastructure is damaged by the disaster.

Thanks to their high maneuverability, UAVs can adjust their aerial position according to the real-time locations of the ground terminals (GTs) for energy efficiency and improving communication performance.

Moreover, by flying over the GTs with a certain altitude, UAV-enabled communication can achieve a better channel quality since the communication links with GTs are mainly dominated by the line-of-sight (LoS) links. For example, a UAV flying at an altitude of 120 m in a rural environment can provide air-to-ground links with the LoS probability that exceeds 95%. Therefore, UAV-enable wireless communication becomes a promising cost- effective paradigm for 5G systems by enabling on demand operations and facilitating the fast and flexible deployment of communication infrastructure.

II. RELATED WORK

UAV trajectory control for energy efficiency has been rigorously studied. In particular, derive a theoretical model on the propulsion energy consumption of fixed-wing UAVs, and an efficient design based on sequential convex optimization is proposed for maximizing the UAV's energy efficiency with general constraints on the trajectory. Based on the energy model, characterize Pareto optimal tradeoffs between uplink transmission energy of the GT and propulsion energy consumption of the UAV. Unlike the aforementioned works in which energy consumption is modeled for fixed-wing UAVs present an analytical model for the propulsion energy consumption of rotary-wing UAVs and a successive convex approximation (SCA) based algorithm was proposed to minimize the UAV energy consumption while ensuring the ground users communication throughput requirements.

Also modeling the propulsion energy consumption of rotary-wing UAVs apply SCA technique for designing a three-dimensional (3D) trajectory, the transmit power and subcarrier allocation for multicarrier solar- powered UAV communication systems.

Without considering propulsion energy consumption the works in optimize UAV's trajectory for throughput maximization. In particular, propose the block coordinate descent and SCA techniques to solve the problem of multiuser communication scheduling and association jointly with the UAV's trajectory and power control. By applying similar techniques as jointly optimize the UAV trajectory and OFDMA resource allocation considering delay- constrained communication. In our prior works the SCA approach is adopted to transform the highly non-convex 2D UAV trajectory control problem and UAV placement problem into a sequence of convex sub problems and the proposed algorithms converge to some local optimum of the original design problems. The aforementioned works are based on traditional one shot optimization techniques that require a number of steps of discretization, relaxation, approximation and iteration to obtain optimal or suboptimal solutions with a high computational complexity. Moreover, these works are based on the assumption that the locations of the GTs are fixed.

III. PROPOSED SYSTEM

A theoretical model for UAV movement, UAV- ground communication, and UAV energy consumption including propulsion and transmission energy consumptions for a rotary-wing UAV. The practical 3-D elevation angle dependent large-scale pathless exponent and small-scale Rician fading to model both the UAV-Ground channels between the UAV and GTs, and backhaul link between UAV and the terrestrial BS. The UAV control problem considers both horizontal and vertical movement control, user scheduling, and communication control that takes into account the real-time dynamics of the environment including real-time locations of GTs, time- varying channel conditions between the UAV and GTs, available onboard energy of the UAV, and the communication requirement of the GTs. The UAV control problem is especially challenging due to highly dynamic communication channel variations from moving objects (i.e., UAV and GTs). Leveraging the advantage of the DRL technique in solving the problems in a stochastic environment, we propose both the off-policy DDPG and on- policy TRPO methods to obtain an optimal policy for the UAV control problem. To the best of our knowledge, this is the first time these methods are simultaneously studied in the UAV control problem. The UAV control problem is formulated as a long-term stochastic non-convex problem which is intractable by traditional optimization approaches.

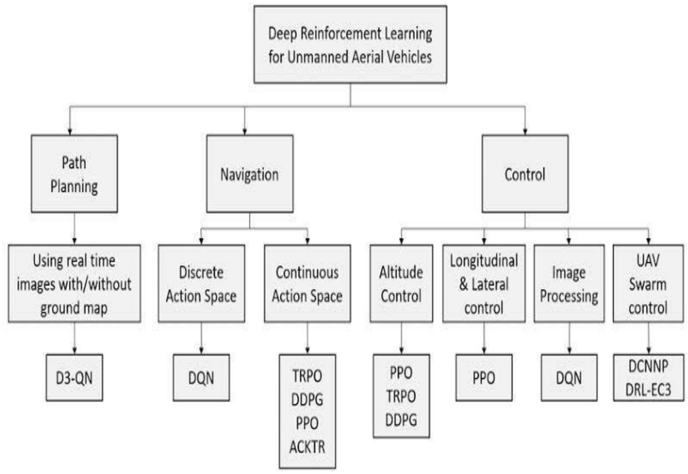

Fig.1. Block diagram of UAV's Endurance Using Efficient Mechanism.

This conclusion can be extended to the dynamic unstable environments in which the off-policy DDPG method may cause sudden failures due to the exploration noise. A study pertaining to the wireless communication aspects for a rotary-wing UAV enabled wireless system as A number of advantages such as taking off, vertical landing, and hovering can be achieved by enabling rotary- wing UAVs in the wireless communication system compared to the standard fixed-wing UAVs. Therefore, we opt to use the rotary- wing UAV as an aerial BS in our system. This UAV will act as a hovering aerial BS that will communicate with multiple GTs to enhance the communication aspects of the network.

IV. EXPERIMENTAL RESULTS

The reward function converges to a stable value gradually with the increase of the episodes in three algorithms. The 'TRPO' algorithm converges to the xy = 10 m/s. have obvious oscillation implies a poor performance while the 'TRPO' algorithm can converge smoothly to a stable. The network performances in terms of the total data throughput of GTs and energy efficiency of the UAV can improve over the training process in three algorithms 'DDPG', 'TRPO', and 'Q-Learning'. It can be observed that both our proposed algorithms 'DDPG' and 'TRPO' converge to the same total data rate value after 5000 episodes. We can see a faster convergence speed of the 'DDPG' algorithm compared to the 'TRPO' algorithm which is similar to the observation.

However, due to the higher energy consumption of the 'DDPG' algorithm compared to the 'TRPO' algorithm, it can be seen that the energy efficiency of the 'TRPO' algorithm is better than that of the 'DDPG' algorithm. This result reveals an improvement of the 'TRPO' algorithm compared to the 'DDPG' algorithm in such a highly dynamic and unstable

UAV environment. Moreover, both 'DDPG' and 'TRPO' algorithms outperform the 'Q-Learning' baseline in terms of both total data rate and energy efficient.

The 'TRPO-Max rate' baseline achieves a lower energy efficiency compared to the 'TRPO' algorithm but still better than the 'DDPG' algorithm. The heuristic baseline 'HSMSS' and the 'Q-Learning' baseline achieve quite similar energy efficiency results and significantly lower than the two proposed 'TRPO' and 'DDPG.

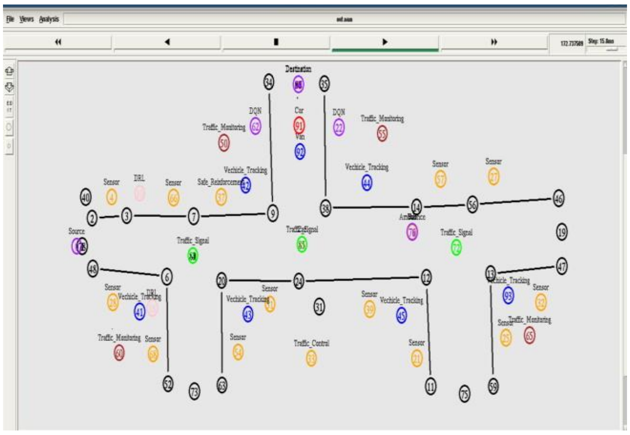

Fig.2. Vehicle Tracking using NS2

The number of GTs to investigate the effect on the performance of the proposed algorithms. As shown in Fig. 9, the energy efficiency of all schemes decreases when the number of GTs increases. The 'TRPO' algorithm achieves the highest energy efficiency compared to all other algorithms for all number of GTs.

V. CONCLUSION

In this paper, we proposed a deep reinforcement learning based approach for UAV control with an objective of energy minimization. We designed two DRL-based algorithms that employ the Deep Deterministic Policy Gradient (DDPG) and Trust Region Policy Optimization (TRPO) methods to achieve a stationary optimal control policy that consists of a number of continuous control variables. We also discussed the practical implementation of our proposed algorithm.

Numerical results reveal the TRPO-based algorithm can improve performance compare to the DDPG-based algorithm in a highly dynamic environment which is the case in this paper. Moreover, both TRPO-based and DDPG based algorithms outperform the baseline 'Q- learning' and heuristic algorithm in terms of energy efficiency.

Irrigation system with automatic sensing techniques. Farmer can get the information about the agricultural field like humidity, temperature and moisture content of the sand through android mobile. The goal of Smart farm monitoring system is achieved by these practical applications of sensors manufacturing tools. Many hurdles for enactment, including reservations by the agriculturalist have been achieved by the recent year's rapid technological approach and evolution.

VI. REFERENCES

[1]O. Regev and N. Nisan, "The popcorn market. online markets for computational resources," Decision Support Systems, vol. 28,no. 1-2, pp. 177 – 189, 2000.

[2]A. Helsinger and T. Wright, "Cougaar: A robust configurable multi agent platform," in Proc. of the IEEE Aerospace Conference, 2005.

[3]J. Brunelle, P. Hurst, J. Huth, L. Kang, C. Ng, D. C. Parkes, M. Seltzer, J. Shank, and S.Youssef, "Egg: an extensible and Economics- inspired open grid computing platform," in Proc. of the GECON, Singapore, May 2006.

[4]J. Norris, K. Coleman, A. Fox, and G. Candea, "On call: Defeating spikes with a free-market application cluster," in Proc. of the International Conference on Autonomic Computing, New York, NY, USA, May 2004.

[5]C. Pautasso, T. Heinis, and G. Alonso, "Autonomic resourceProvisioning for software business processes," Information And Software Technology, vol. 49, pp. 65–80, 2007.

[6]A. Dan, D. Davis, R. Kearney, A. Keller, R.King, D. Kuebler, H. Ludwig, M. Polan, M. Spreitzer, and A. Youssef, "Web Services ondemand: Wsla-driven automated management," IBM Syst. J., vol. 43, no. 1, pp. 136–158, 2004.

[7]M. Wang and T. Suda, "The bio-networking architecture: a biologically inspired approach to the design of scalable, adaptive, and survivable/available network applications," in Proc. of the IEEE Symposium on Applications and the Internet, 2001.

[8]N. Laranjeiro and M. Vieira, "Towards fault tolerance in Web services compositions," in Proc. of the workshop on Engineering fault tolerant systems, New York, NY, USA, 2007.

[9]C. Engelmann, S. L. Scott, C. Leangsuksun, and X. He, "Transparent symmetric active/active replication for service level High availability," in Proc. of the CCGrid, 2007.

[10]J. Salas, F. Perez-Sorrosal, n.-M. M. Pati and R. Jim´enez-Peris, "Ws-replication: a framework for highly available web Services," in Proc. of the WWW, New York, NY, USA, 2006.

[11]L. Lamport, “The part-time parliament,” ACM Transactions on Computer Systems, vol. 16, pp. 133–169, 1998.

[12]N. Bonvin, T. G. Papaioannou, and K. Aberer, “Cost-efficient and differentiated data availability guarantees in data clouds,” In Proc. of the ICDE, Long Beach, CA, USA, 2010.

[13]M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. H. Katz, A. KonwiNSki, G. Lee, D. A. Patterson, A. Rabkin, I. Stoica, and M. Zaharia,“Above the clouds: A berkeley view of cloud computing,” University of California, Berkeley, Tech. Rep. USB-EECS-2009-28, Feb 2009.