Wu, X.; **Feng, Z.**; **Zhu, J.**; **Allen, R.**
GA-based path planning for multiple AUVs. (English) Zbl 1119.93013
Int. J. Control 80, No. 7, 1180-1185 (2007).

Summary: The genetic algorithm (GA), which is a simulation of Darwinian evolution and an efficient way for large-scale optimization subject to non-linear constraints, is applied to find economical and safe routes for a swarm of AUVs to revisit an area with waypoints and obstacles which are known a priori. The algorithm can be divided into three phases: (1) waypoint assignment: allocating the waypoints to individual AUVs; (2) route optimization: minimizing the total journey of the vehicles and (3) route validation: checking whether there exist stationary and/or moving collisions. A case study for three AUVs to survey a given area is also presented to verify the algorithm.

MSC:

93A30 Mathematical modelling of systems (MSC2010)
90C59 Approximation methods and heuristics in mathematical programming
93C85 Automated systems (robots, etc.) in control theory

Keywords:

genetic algorithms (GA); non-linear constraints; swarms; path planning

Full Text: DOI

References:

[1] Bellingham, JS, Tillerson, M, Alighanbari, M and How, JP. 2002. Cooperative path planning for multiple UAVs in dynamic and uncertain environments. Proceedings of the IEEE Conference on Decision and Control. 2002, Las Vegas, NV, United States. pp.2816–2822.

[2] Fogel, DB and Fogel, LJ. 1990. Optimal routing of multiple autonomous underwater vehicles through evolutionary programming. Proceedings of the Symposium on Autonomous Underwater Vehicle Technology. 1990, Washington, DC, USA. pp.44–47.

[3] Fregene, K, Madhavan, R and Kennedy, D. 2004. Coordinated control of multiple terrain mapping UGVs. IEEE International Conference on Robotics and Automation. 2004, New Orleans, LA, United States. pp.4210–4215.

[4] DOI: 10.1016/j.robot.2005.01.001 · Zbl 02223512 · doi:10.1016/j.robot.2005.01.001

[5] Potvin JY, Ann. Oper. Res. pp 339– (1996)

[6] Ramakrishnan, R and Zein-Sabatto, S. 2001. Multiple path planning for a group of mobile robot in a 2-D environment using genetic algorithms. Conference Proceedings – IEEE SOUTHEASTCON. 2001, Clemson, SC, USA. pp.65–71.

[7] DOI: 10.2514/1.7370 · doi:10.2514/1.7370

[8] Shima, T, Rasmussen, SJ and Sparks, AG. 2005. UAV cooperative multiple task assignments using genetic algorithms. Proceedings of the American Control Conference. 2005, Portland, OR, United States. pp.2989–2994.

[9] Sousa, J, Cruz, N, Matos, A and Lobo, PF. 1997. Multiple AUVs for coastal oceanography. Oceans Conference Record (IEEE). 1997. Vol. 1, pp.409–414.

[10] Stack, JR, Smith, CM and Hyland, JC. 2004. Efficient reacquisition path planning for multiple autonomous underwater vehicles. Ocean '04 – MTS/IEEE Techno-Ocean '04: Bridges Across the Oceans. 2004. pp.1564–1569.

[11] Stilwell, DJ, Gadre, ASA and CCJ. 2004. Design elements of a small low-cost autonomous underwater vehicle for field experiments in multi-vehicle coordination. IEEE/OES Autonomous Underwater Vehicles. 2004. pp.1–6.

[12] Vasudevan, C and Ganesan, K. 1994. Case-based path planning for autonomous underwater vehicles. IEEE International Symposium on Intelligent Control – Proceedings. 1994. pp.160–165.

[13] Warren, CW. 1990. A technique for autonomous underwater vehicle route planning. Proceedings of the Symposium on Autonomous Underwater Vehicle Technology. 1990. pp.201–205.