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# EXPERIMENTAL RESULTS OF LUNAR SOFT LANDING SOLVED VIA SWARM INTELLIGENCE

**Abstract**

The paper proposes an approach to search the suitable solution of the optimal lunar soft landing using the Particle Swarm Optimization (PSO). This method presumes the evolution of a group of candidate solutions called particles that move through the feasible search space, which indicates the set of all acceptable and meaningful solutions. Recently, the authors of this paper have proposed a modified technique, named Inverse Dynamics Particle Swarm Optimization (iPSO), which does not involve the integration of the dynamics and where the trajectory constraints and the final conditions are directly satisfied. The paper shows the preliminary results of the iPSO applied to the problem of lunar landing where the fitness function includes the fuel consumption of the maneuver. Experimental results of the proposed approach are given using the Landing Lunar Simulator of the Automation, Robotics an Control for the Aerospace Lab (ARCAlab). The facility has been constructed thanks to the collaboration among professors and students of the School of Aerospace Engineering. It consists of a simulated surface and a triaxis moving frame (a Cartesian robot) equipped with distance sensors and a video camera. In particular, a site of the Moon located on the Mare Serenitatis has been selected as simulated surface . The surface is scaled in dimensions w.r.t. the real site of a factor 1:2000. The reason to have a scalable surface scenario is the use of cameras in the navigation of landing space vehicles for different phases of the descending trajectory. The paper focuses on the experimental results of the optical navigation and the optimal guidance via iPSO. The optical navigation exploits a craters recognition algorithm applied to the acquired im-ages of the on board camera during the simulated descending path of the lander. The processed im-ages are the input to the hazard avoidance tech-inique, based on the iPSO, that drives the moving frame toward a safe landing.