20th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Distributed Space Missions (7B)

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# GPU ACCELERATED GENETIC ALGORITHM FOR IN-SAR CLUSTER CONFIGURATION KEEPING ACROSS-TRACK BASELINE UNDER THE J2 PERTURBATION

**Abstract**

In recent years, distributed small satellites interferometer synthetic aperture radar (In-SAR) has been attracted many attentions for superior performance and potential application. According to the principle of In-SAR, baseline parameter is one of important factors. Such as the across-track baseline exert a great influence on the relative height measurement accuracy. The across-track baseline of the In-SAR system can't configure to constant unless infinite satellites are employed. Fortunately, we can get the near-constant across-track baseline from 3-satellites formation. From above method we can approximately keep the stability of the across-track baseline.

Several approaches for creating J2 invariant relative orbit have been proposed recently. It is difficult to design the closed-loop real-time control in the relative rectangular coordinates system; If it design the control strategy based on the C-W equation, the algorithm will be complexity and difficult to gauge the influence of J2 perturbation. What the formation should meet is the restriction of low energy consumption control and high precision measurement. In this paper we use the relative orbital elements to creating J2 invariant relative orbit. The control feedback is pulse thrust in a whole cycle which is designed by the difference of the relative closed track. From above control strategy, we get the J2 invariant relative orbit. However the J2 invariant relative orbit may be quite different from the desired orbit. The bad situation is which are nearly vertical. Different formations have different mathematical definitions for compatibility. The compatibility between invariant orbits and formation configuration is defined as the similarity of them. So the more similar they are, the better compatibility they have, and vice versa.

In this paper, we used genetic algorithm to search the best situation. In order to improve the convergence rate of gene algorithm, the Graphics Processing Unit (GPU) was proposed. The approach builds from the concepts of parallel heterogeneous programming utilizing both the central processing unit (CPU) and GPU in tandem to achieve multiple orders of magnitude speedup. The results by the example of three satellites formation show that: (1) Optimal formation gets the near-constant across-track baseline and effectively prevents drifts on the along-track direction (2) The GPU acceleration genetic algorithm reduces the operation time and improves the precision. From the superior performance of GPU, it will be widely used in the future of the spacecraft design.