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Author: Mr. Jia Tian
China Academy of Space Technology (Xi'an), China, jia_epfl_tian@163.com

Mr. Lei Huang
China Academy of Space Technology (CAST), China, 54644122@qq.com
Mr. Peng Gao
China Academy of Space Technology (CAST), China, 1307209727@qq.com
Mrs. Ting Liang
China Academy of Space Technology (CAST), China, liangt@cast504.com
Mrs. Dan Chen
China Academy of Space Technology (CAST), China, 2931422378@qq.com
Mr. Zeyue Meng
China Academy of Space Technology (CAST), China, mengzy@88.com

THE HIGH SENSITIVITY SELF-ADAPTIVE ACQUISITION METHOD FOR SMALL MOON MISSION

Abstract

As we all know, the GPS navigation constellation has provided extremely efficient services for ground users and low earth orbit vehicles, such as location determination and time synchronization. Therefore, if the GPS signal could be sufficiently used in the small lunar probe, it will bring great benefits to the extremely limited weight and power consumption of the probe. However, there are some reasons which restrict the application of the small moon mission. The obvious one is the signal acquisition problem. Generally, only rough data boundary and carrier frequency estimation could be got by the acquisition module because of the FPGA resource limitation of space borne product. For GPS L1 signal, the accuracy of acquisition frequency could only reach 25Hz, and the ambiguity of data boundary is 5 CA codes. So the precision of the acquisition result is not high enough to make the tracking loop converge in high sensitivity situation. To solve this problem, the normal method is to use tremendous FPGA resource to implement acquisition module and reduce Doppler bin search width. But the drawbacks are obvious: 1) even if the space borne product could meet the resource requirement of the acquisition module, it will increase the cost, power consumption and weight; 2) more time will be consumed in the acquisition process, and the time required for the first position will be greatly prolonged. In this paper, the high sensitivity self-adaptive acquisition method for small moon mission is presented, which will be used in Chinese CE-7 lunar mission. The algorithm adopts open loop rotation transform architecture to predict the data boundary and residual carrier frequency, the prediction accuracy is 0.25chip and 0.5Hz in high sensitivity situation (-159dBm). The real simulation experiment (Spirent 8000) shows that this method can work well in the moon navigation mission with reasonable resource (Altera EP3SE260F: 4 percent ALMs, 5 percent DSP and 4 percent RAM).