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WHOLE MTO ORBIT SELF-ADAPTIVE TRACKING METHOD BASED ON FPGA RESOURCE RESTRICTED PLATFORM

Abstract

Nowadays, there is an increasing interest about the space applications based on Global positioning system (GPS), but most of them just focus on low earth orbit (LEO), Medium earth orbit (MEO) or high earth orbit (HEO) separately, because each orbit has totally different signal characteristics from GPS. In LEO, the GPS signal is quite strong (up to -120dBm), but also the dynamic is very big (70Hz/s). In MEO, the GPS signal is normal (-143dBm), and the dynamic is normal too (21Hz/s). In HEO, the GPS signal is very weak (-169dBm), and dynamic is equivalently small (maximum 5Hz/s). In order to extend current space applications, such as the MTO orbit (Earth - Moon transfer orbit), which is one example of highly elliptical orbit in which a spacecraft travels from LEO to HEO, the traditional method is integrating different tracking methods together. But the drawback is obvious, the resources needed are very big, which is very harmful for space applications that require small volume and small mass components. In this paper, the whole MTO orbit self-adaptive tracking method is presented, which can not only satisfy the requirements of different parts of the orbit, but also significantly decrease the FPGA resources needed. Compared with traditional method, this method designs universal VHDL part which can fit different tracking demands, and controls it by SOC part of FPGA. It will bring huge benefits to the GPS receiver: 1) the fixed universal VHDL part means the resource needed for tracking part is reduced tremendously; 2) the SOC part which is aided by other sub-systems (like INS, orbit filter) can control the tracking parameters, which means it can adapt to different GPS signal characteristics. The real simulation experiment (Spirent 8000) shows that this method can work well in the whole MTO orbit with reasonable resource (ALTERA EP3SE260F: 6.3% ALMs, 15.3% DSP and 11.5% RAM).