电子与信息学报 2009 31 (11): 2671-2676 ISSN: 1009-5896 CN: 11-4494/TN

论文

无人机载软件接收机同步方案研究

熊海良[①], 肖 竹[①], 杨 宏[①②], 田红心[①], 易克初[①]

[①]西安电子科技大学综合业务网理论及关键技术国家重点实验室 西安 710071; [②]中国空间技术研究院总体部 北京 100094

收稿日期 2008-11-11 修回日期 2009-5-7 网络版发布日期 2009-11-17 接受日期

摘要
为确保无人飞机进行稳定的数据传输，该文提出了一种基于部分匹配滤波器和两级FFT的快速同步捕获算法，该算法能在搜索出同步点位置的同时，有效估计载波频偏，且计算复杂度显著下降。在动态环境中，载波多普勒频移变化剧烈，普通接收机跟踪环容易失锁，该文提出了一种基于经验值查表的载波跟踪算法，在锁频环内引入经验值查找表，环路能自适应调整滤波器带宽，任意时刻都能保证高精度跟踪。仿真实验表明，当输入信噪比高于-35 dB，载波初始多普勒频偏在±12.8 kHz以内，机动载体相对于卫星转发器的径向加速度为5 m/s^2(等效多普勒频移变化速度为180 Hz/s)，无人机载软件接收机可以进行稳定的数据传输。

关键词 无人机 同步捕获 部分匹配滤波器和两级FFT 载波跟踪 经验值查找表

分类号

Investigation of Synchronization for Software Receivers on Unmanned Aerial Vehicles(UAVs)

Xiong Hai-liang[①], Xiao Zhu[①], Yang Hong[①②], Tian Hong-xin[①], Yi Ke-chu[①]

[①]State Key Lab of Integrated Service Networks, Xidian University, Xi'an 710071, China; [②]China Academy of Space Technology, Beijing 100094, China

Abstract
To ensure the reliability of the data transmitting for the Unmanned Aerial Vehicles (UAVs) in dynamic environment, a novel class of fast acquisition algorithm based on Partial Matched Filters and Two-Leveled FFT(PMF-TLFFT) is proposed, which is capable of searching for the code synchronization point as well as estimating the carrier-frequency offset for correction. However, in dynamic environment, as the UAVs usually possesses a larger axial acceleration compared with that of the satellite repeater, the Doppler frequency shifts dramatically, making the tracking loop of a general receiver out of balance. Therefore, An FPLL based on Look-Up Tables (LUT-FPLL) is presented, which employs a list of experiential values in FLL and the bandwidth of the loop filter in FLL is adaptively adjusted, this ensures the high precision tracking performance. Simulation results demonstrate that with the input SNR higher than -35 dB, initial carrier-frequency offset ranging from -12.8 kHz to +12.8 kHz and axial acceleration 5 m/s^2 the receiver on the UAVs can efficiently and reliably work.

Key words Unmanned Aerial Vehicles (UAVs) Code-acquisition Partial Matched Filters and Two-Leveled FFT (PMF-TLFFT) Carrier tracking Look-Up Tables (LUT)

DOI:

通讯作者

作者个人主页 熊海良[①]; 肖 竹[①]; 杨 宏[①②]; 田红心[①]; 易克初[①]