**2022年英特尔杯大学生电子设计竞赛嵌入式系统专题邀请赛**

**参赛队作品简介**

|  |  |
| --- | --- |
| **参赛学校** | 哈尔滨工程大学 |
| **指导教师** | 侯长波 |
| **参赛队员** | 王阳 | 郭济铭 | 王晨昊 |
| **作品题目****（中英文对照）** | 智能电磁信号分析与干扰嵌入式系统Intelligent EM Signal Analysis and Interference Embedded System |
| **作品****简介****（中****英文****对照****，中****文限****500字以****内）** | 随着无线通信技术的发展，传统电子战逐渐向电磁战靠拢，为了实时精准感知和掌控战场的频谱态势，针对电磁信号的频谱感知技术成为重点。十九大报告中指出要加快军事智能化发展，夺取电磁频谱优势对于维护国家战略利益至关重要。针对传统电磁感知设备体积大、人工操作繁琐并且功能单一，集成度低的问题，本团队设计了一款智能化的电磁信号感知与干扰设备，弥补传统设备的不足，用于提升我军的频谱管控能力。本作品使用英特尔嵌入式边缘计算平台，研制了集多信号分离、侦察、识别和干扰与一体的电磁信号智能分析与干扰嵌入式系统。针对多信号识别准确率较低的问题，本作品结合Inception模块、注意力机制与频域滑窗理论，提出了一种基于复数神经网络的多信号分离识别算法；针对边缘计算平台“低功耗轻量化”的要求，本作品使用知识蒸馏的方法大大减少模型所用参数，提高模型的准确率与运算速度；针对传统干扰效能低、功率大的问题，本作品提出特征级灵巧干扰波形生成算法，提升设备的干扰效果。 本作品利用实采数据构建的电磁样本库对模型进行训练以及参数压缩，经实验测试，可以有效将多信号进行检测与分离，对三种调制信号的识别准确率达到96%以上，对于响应国家作战装备的集成化、智能化发展具有重大意义。With the development of wireless communication technology, traditional electronic warfare is gradually approaching to electromagnetic warfare. In order to accurately perceive and control the frequency situation of the battlefield in real time, spectrum sensing technology for electromagnetic signals becomes the focus. In the report of the Nineteenth National Congress, it is pointed out that in order to speed up the development of military intelligence, it is essential to seize the advantages of electromagnetic spectrum for safeguarding the national strategic interests.In order to solve the problems of large size, cumbersome manual operation, single function and low integration of traditional electromagnetic sensing devices, our team designed an intelligent electromagnetic signal sensing and interference device to make up for the deficiencies of traditional devices and to improve the frequency control capability of our army.We use Intel embedded edge computing platform to develop an embedded system for intelligent analysis and interference of electromagnetic signals, which integrates multi-signal separation, detection, recognition and interference. For the low accuracy of multi-signal recognition, our system combines Inception module, attention mechanism and frequency domain sliding window theory, and presents a multi-signal separation and recognition algorithm based on complex number neural network. For the requirement of "low power consumption and lightweight" edge computing platform, we uses knowledge distillation method to greatly reduce the parameters used in the model, and improve the accuracy and speed of the model. To solve the problem of low efficiency and high power of traditional interference, we puts forward a smart interference waveform generation algorithm of feature level to improve the interference effect of the device. |
| **作品****简介** | The model is trained and the parameters are compressed by using the electromagnetic sample library constructed from the real data. The experimental tests show that the multi-signals can be effectively detected and separated. The recognition accuracy of the three modulated signals can reach more than 96%, which is of great significance for the integration and intelligence development of the national warfare equipment. |

注： 1．请使用小4号字（12号字），单倍行距填写；

2．每支参赛队限一名指导教师；

3．参赛队员姓名应与正式报名表一致；

4．作品题目应与作品设计报告一致。