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Brain-Computer Interface Based Real-Time Control of Fixed Wing and Multi-Rotor Unmanned Aerial Vehicles

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Abstract : Brain-computer interfacing (BCI) is a technology that is almost four decades old, and it was developed solely for the purpose of developing and enhancing the impact of neuroprosthetics. However, in the recent times, with the commercialization of non-invasive electroencephalogram (EEG) headsets, the technology has seen a wide variety of applications like home automation, wheelchair control, vehicle steering, etc. One of the latest developed applications is the mind-controlled quadrotor unmanned aerial vehicle. These applications, however, do not require a very high-speed response and give satisfactory results when standard classification methods like Support Vector Machine (SVM) and Multi-Layer Perceptron (MLPC). Issues are faced when there is a requirement for high-speed control in the case of fixed-wing unmanned aerial vehicles where such methods are rendered unreliable due to the low speed of classification. Such an application requires the system to classify data at high speeds in order to retain the controllability of the vehicle. This paper proposes a novel method of classification which uses a combination of Common Spatial Paradigm and Linear Discriminant Analysis that provides an improved classification accuracy in real time. A non-linear SVM based classification technique has also been discussed. Further, this paper discusses the implementation of the proposed method on a fixed-wing and VTOL unmanned aerial vehicles.

Keywords : brain-computer interface, classification, machine learning, unmanned aerial vehicles
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