

EEG Biometric

The need is for a biometric to identify trusted insiders irrefutably. Additional requirements for a biometric are: secure; privacy protecting; capable of meeting Federal standards for reliability and accuracy; and adaptable to regional, state, and local requirements. The objectives are to deter identity deception and to accelerate recognition of trusted personnel (e.g., authorized firearm carriers in air travel, state/regional/local officials, and trusted insiders in critical infrastructure areas). We propose an EEG signature as a new biometric. Authentication would require a living cooperative person, as opposed to inanimate records that can be forged, or passive biometric identifiers that can be extracted from someone who is uncooperative, or even dead. EEG acquisition via an appropriate antenna may allow covert identification of personnel. To meet these needs, Oak Ridge National Laboratory (ORNL) has developed a novel statistical paradigm for capturing an EEG signature (brain-print) from noisy, non-invasive, scalp brain-wave data.

The Solution is protected by six U.S. patents (and two patents pending). The method first rejects data of inadequate quality. Next, the method removes confounding artifacts (e.g., eye blinks and other muscular artifacts) by a novel filter. The artifact-filtered data then are converted to a statistical distribution function (DF) that captures the essence of the brain dynamics. EEG signature analysis requires detection of large dissimilarity between the known EEG signature (enrollment) and test data for true negatives (correct determination that the data are from different people), as well as recognition of insignificant change (small dissimilarity between the enrollment and test data for the same person).

Existing forms of the technology give event forewarning via several sequential occurrences of the dissimilarity measures above a threshold. Examples include forewarning of epileptic seizures from scalp brain waves (total true rate = $f_T = 56/60$); of ventricular fibrillations ($f_T = 5/5$) and fainting ($f_T = 2/2$) from surface heart waves; detection of sepsis onset ($f_T = 23/23$), and breathing difficulty from surface chest sounds ($f_T = 2/2$). Companion work shows forewarning of machine failures from motor power and tri-axial acceleration ($f_T = 17/17$). This approach also provides an indication of machine failure onset. The consistent successes for such diverse applications give strong credibility to the robustness of the novel statistical method. The technology readiness level (TRL) is five, involving integrated, high-fidelity tests of the technology components in realistic environments. *R&D Magazine* awarded its prestigious R&D100 Award in 2005 to ORNL's SeizAlert technology, which is a low-cost, compact, prototype PDA device to alert the wearer and medical personnel of an impending epileptic seizure. The technology is licensed to a start-up company for epilepsy forewarning from brain waves, and cardiac-event forewarning from heart waves. A validation trial will soon begin at Cleveland Clinic – Hively.

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