Turkish Journal

of

Electrical Engineering & Computer Sciences

Keywords
Authors

elektrik@tubitak.gov.tr

Scientific Journals Home Page

Turkish Journal of Electrical Engineering & Computer Sciences

Asynchronous signal processing for brain-computer interfaces

Seda ŞENAY[1], Luis F. CHAPARRO[1], Mingui SUN[1,2], Robert SCLABASSI[1,2], Aydın AKAN[3]

[1]Department of Electrical and Computer Engineering, 348 Benedum Hall, Pittsburgh, PA, 15261 USA
e-mail: chaparro@ee.pitt.edu

[2]Laboratory for Computational Neuroscience, Department of Neurosurgery, University of Pittsburgh, Pittsburgh, PA, 15261 USA

[3]Department of Electrical and Electronics Engineering, İstanbul University, 34320, Avcılar, İstanbul-TURKEY
e-mail: akan@istanbul.edu.tr

Abstract: Brain-computer interfaces (BCIs) provide a way to monitor and treat neurological diseases. An important application of BCIs is the monitoring and treatment of epilepsy, a neurological disorder characterized by recurrent unprovoked seizures, symptomatic of abnormal, excessive or synchronous neuronal activity in the brain. BCIs contain an array of sensors that gather and transmit data under the constrains of low-power and minimal data transmission. Asynchronous sigma delta modulators (ASDMs) are considered an alternative to synchronous analog to digital conversion. ASDMs are non-linear feedback systems that enable time-encoding of analog signals, from which the signal can be reconstructed. An efficient reconstruction of time-encoded signals can be achieved using a prolate spheroidal waveform (PSW) projection. PSWs have finite time support and maximum energy concentration within a given bandwidth. The ASDM time-encoding is related to the duty-cycle modulation and demodulation, which shows that sampling is non-uniform. For transmission of data from BCI, we propose a modified orthogonal frequency division multiplexing (OFDM) technique using chirp modulation. Our method generalizes the chirp modulation of binary streams with non-uniform symbol duration. Our theoretical results relate to recent continuous-time digital signal processing and compressive sampling theories.

Key words: Asynchronous sigma delta modulators (ASDM), brain computer interface (BCI), wireless OFDM communications, prolate spheroidal waveform (PSW), chirp modulation

---

Turk. J. Elec. Eng. & Comp. Sci., **19**, (2011), 275-289.
Full text: pdf
Other articles published in the same issue: Turk. J. Elec. Eng. & Comp. Sci.,vol.19,iss.2.