

Deep Learning Algorithms for Signal Recognition in Long Perimeter Monitoring Distributed Fiber Optic Sensors

A. V. Makarenko^{a, b, 1}

^a Constructive Cybernetics Research Group
P.O.Box 560, Moscow, 101000 Russia

^b Institute of Control Sciences, Russian Academy of Sciences
ul. Profsoyuznaya 65, Moscow, 117977 Russia

Received April 27, 2016; in final form, July 28, 2016.

Abstract. In this paper, we show an approach to build deep learning algorithms for recognizing signals in distributed fiber optic monitoring and security systems for long perimeters. Synthesizing such detection algorithms poses a non-trivial research and development challenge, because these systems face stringent error (type I and II) requirements and operate in difficult signal-jamming environments, with intensive signal-like jamming and a variety of changing possible signal portraits of possible recognized events. To address these issues, we have developed a two-level event detection architecture, where the primary classifier is based on an ensemble of deep convolutional networks, can recognize 7 classes of signals and receives time-space data frames as input. Using real-life data, we have shown that the applied methods result in efficient and robust multiclass detection algorithms that have a high degree of adaptability.

Keywords: deep learning, fiber optic vibration sensors, signal recognition, events classification, t-SNE visualization.

¹E-mail: avm.science@mail.ru