

The background theory of point processes, spatio-temporal point processes, random measures and random closed sets is given in the beginning of the thesis. Then the special case of spatio-temporal Cox processes constructed from Lévy basis is studied. Formulas for theoretical characteristics are derived using the generating functional. The Cox process on the curve is defined and studied. The analysis of such a process leads to nonlinear filtering methods. Also the methods for model selection are discussed. These methods are used on simulated data, firstly on the simple discrete data and secondly on the continuous data where the curve is a spiral. Then the real data from a neurophysiology experiment is analysed. During the experiment, the spiking activity of a place cell of hippocampus of a rat moving in an arena together with the track of the rat was recorded. The track of the rat and the action potentials (spikes) present the curve and the points on it. At the end of the thesis, other approaches to neurophysiological data are discussed. The first one is an estimation of a conditional intensity of the temporal process of spikes using recursive filtering. In the second one, the track of the rat together with the random driving intensity function of the process of the spikes is viewed as a random marked set.