TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV


INTERNATIONAL CONFERENCE

# PROBABILITY, RELIABILITY AND STOCHASTIC OPTIMIZATION

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CONFERENCE MATERIALS

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# INFINITESIMAL GENERATOR FOR THE DISCRETE HIDDEN MARKOV MODEL


S. A. Semenyuk[1], Ya. M. Chabanyuk[2], U. T. Khimka[3]


Consider hidden Markov model (HMM) as a two-component process $z_t = (x_t, y_t)$. Here the HMM state process $x(t), t \geq 0$ is uniformly ergodic Markov process in the standard phase space $(X, \boldsymbol{X})$ with a generator [1]:

$$Q\varphi(x) = q(x) \int_X P(x, dy) \left[\varphi(y) - \varphi(x)\right], \quad \varphi \in \mathbf{B}(X),$$

B denotes Banach space of real bounded functions with supremum norm $||\varphi|| = \max_{x \in X} |\varphi(x)|$. Let process $x(t)$ have stationary distribution $\pi(C), C \in \boldsymbol{X}$.

And the HMM observation process $y(t), t \geq 0$ is a sequence of random variables with set of probability mass functions: $b_x(y) = P[y_t = y | x_t = x], y \in Y$.

It can be shown that the process $z_t$ is Markovian, moreover, it is ergodic and stationary if $x_t$ is ergodic and stationary [2].

**Lemma 1.** *Infinitesimal generator for the two-component Markov process $z_t = (x_t, y_t)$, $t \geq 0$ has the form:*

$$L\varphi(x, y) = q(x) \int_X P(x, ds) \sum_{p \in Y} \left[b_s(p)\varphi(s, p) - b_x(p)\varphi(x, p)\right], \quad \varphi \in \mathbf{B}(X, Y).$$

Obtained result allows to consider and study complex stochastic systems that depends on hidden Markov models [3].

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