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Optimal Control Problem for a Conveyor-Type Production Line

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Abstract. A method for constructing optimal control of the conveyor-type flow line parameters is developed. The model of the conveyor line is represented by the partial differential equation, which allows to take into account the distribution of products along the technological route as a function of time. Various variants of stepped speed control of the conveyor belt are investigated. The features of step control are determined. The divergence the rate of output by the flow line from the given demand for different parameters of step control is shown.

KEYWORDS: conveyor, a subject of a labour, production line, PDE-model of the production, parameters of the state of the production line, technological position, transition period, production management systems

INTRODUCTION

Competitive capacity of a flow production depends on the system of control of parameters of the production line. To design management systems for modern flow production lines, discrete-event models (DES models) [1], queueing theory models (QN models) [2], fluid models [3], and models with application of partial differential equations (PDE models) [4, 5] are most often used. The class of PDE models of production lines was generated due to the global tendency of the development of flow production systems, which implies reduction of production cycle under nonstationary demand for the goods [6]. A considerable part of the life cycle, flow production lines operate with a variable in time productivity of the output. The manufacture development factors listed above substantially limited the possibility of using

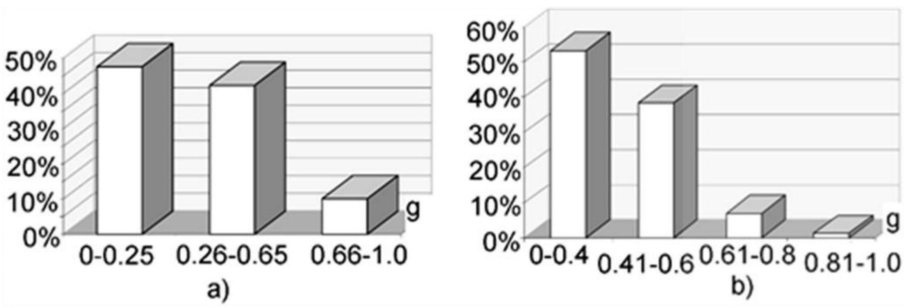

Fig. 1. The diagram of the relative velocityg Vn□ □ /of belt conveyorthroughout days: a — WESTFALEN mine (Germany);b — KWK ANNA mine (Poland).

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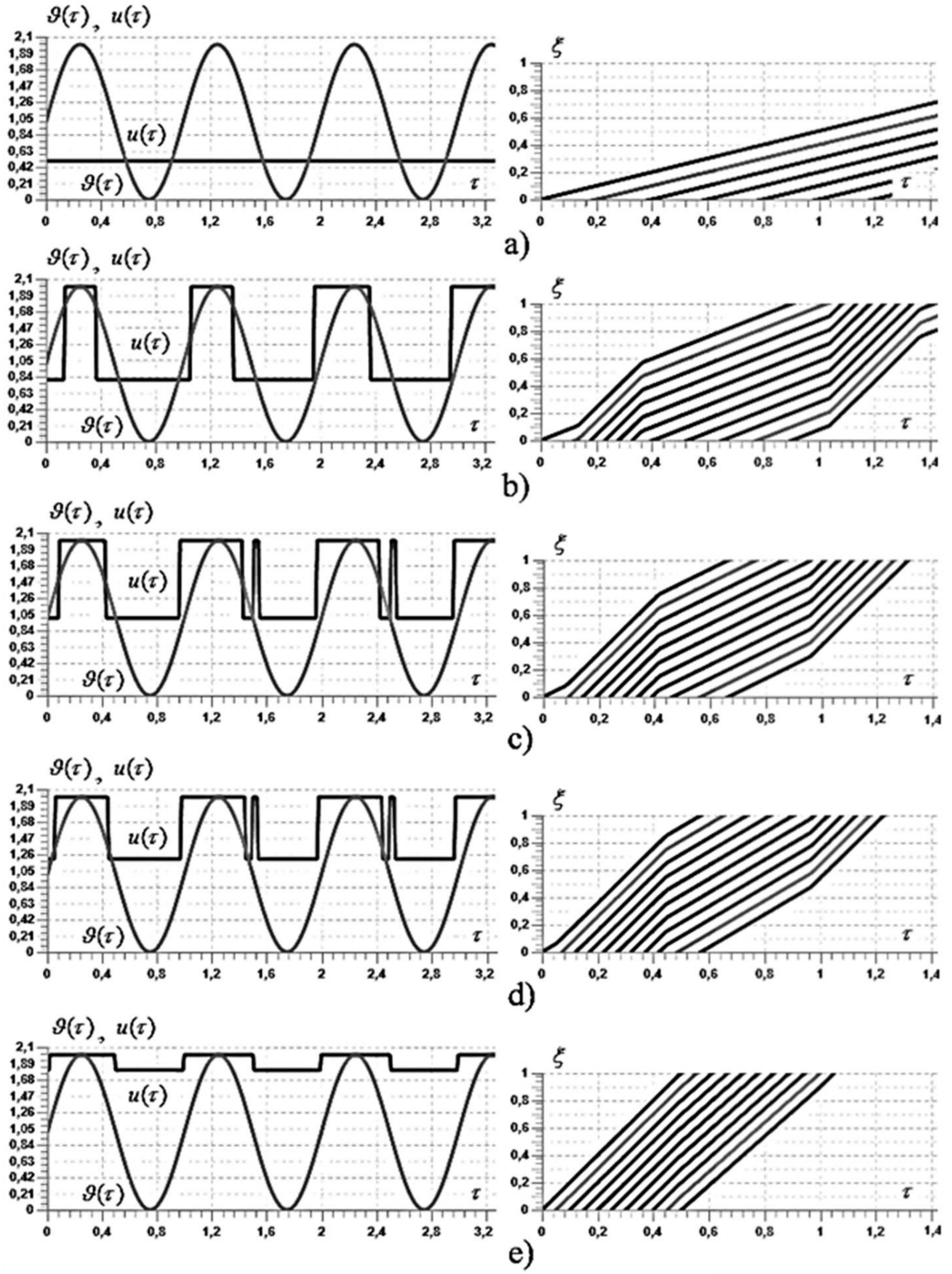

Fig. 2. Graphs of the optimal control of the speed and families of characteristics

a) $u(\tau) = (0.5, 2.0)$; b) $u(\tau) = (0.8, 2.0)$; c) $u(\tau) = (1.0, 2.0)$; d) $u(\tau) = (1.2, 2.0)$; d) $u(\tau) = (1.8, 2.0)$

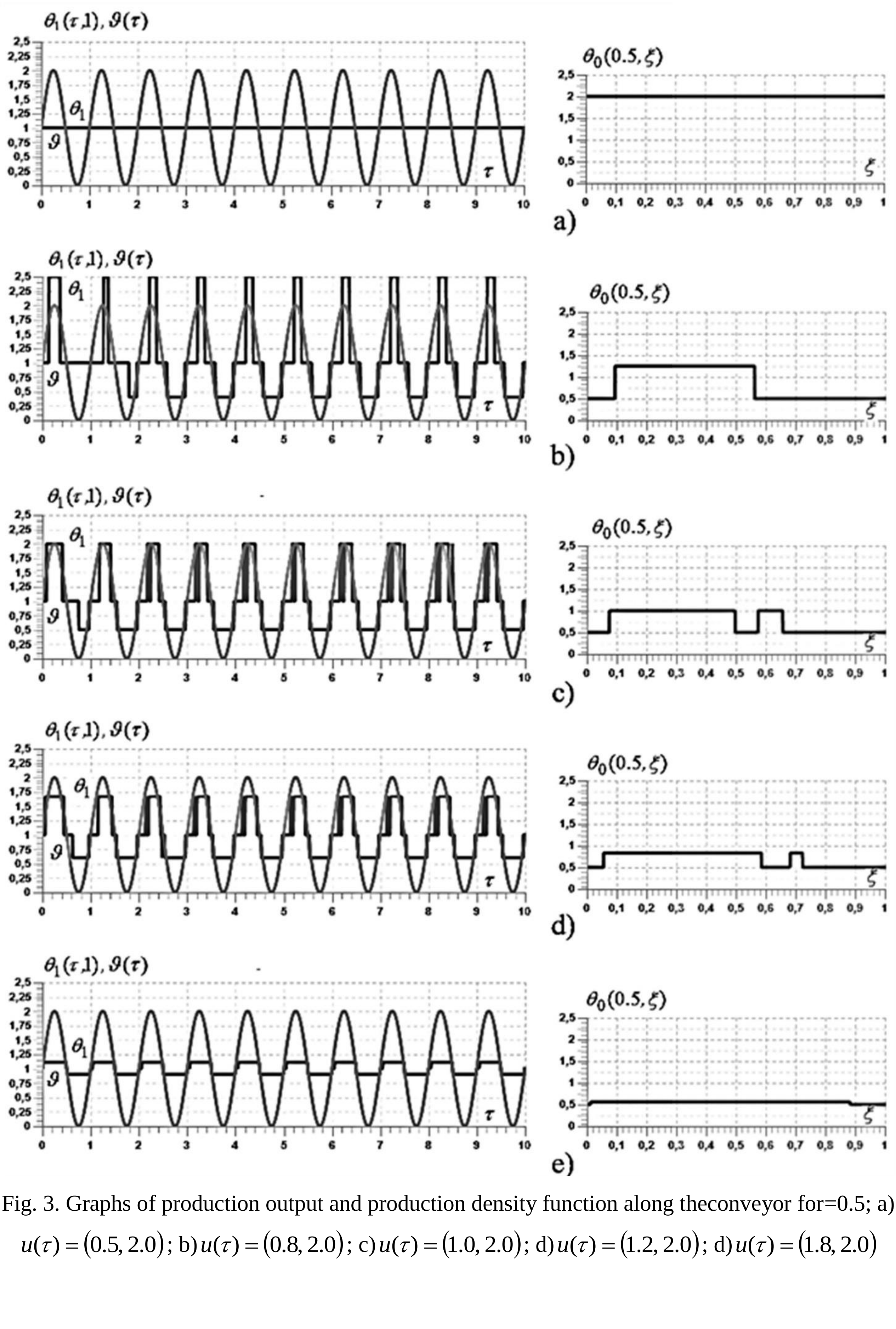

Fig. 3. Graphs of production output and production density function along theconveyor for=0.5; a) $u(\tau)=(0.5, 2.0)$; b) $u(\tau)=(0.8, 2.0)$; c) $u(\tau)=(1.0, 2.0)$; d) $u(\tau)=(1.2, 2.0)$; d) $u(\tau)=(1.8, 2.0)$

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