## Nonlinear impulsive system of microbial production in fed-batch

## culture and its optimal control

Enmin Feng<sup>1</sup>, Caixia Gao<sup>1</sup>, zhilong Xiu<sup>2</sup>

(1. Department of Applied Mathematics, Dalian University of Technology, Dalian, Liaoning, 116024, P. R. China. Email: <u>emfeng@dlut.edu.cn</u>, gaocx0471@163.com)

(2. Department of Biotechnology, Dalian University of Technology, Dalian, Liaoning, 116012, P. R. China. Email: zlxiu@mail.dlptt.ln.cn)

## Abstract

In this study the optimal control of fed-batch glycerol fermentation is investigated based on an impulsive dynamical system. Considering the sudden increase of the glycerol and alkali in fed-batch culture of biodissimilation of glycerol to 1,3-propanediol, this paper proposes a nonlinear impulsive system of fed-batch culture. The existence, uniqueness and regularity properties of solution for the system are proved. In view of the controllability of volumes of glycerol added to the reactor instantaneously, the paper constructs an optimal control model based on the nonlinear impulsive system and the existence of the optimal control is obtained. The control variables here are the moments and the sizes of jumps in the states at the discrete instants and the objective is to maximize the productivity of 1,3-propanediol over one cycle.

Key words: fed-batch culture; nonlinear impulsive system; optimal control