INTERNATIONAL SCIENTIFIC CONFERENCE

CIBv 2010

12 – 13 November 2010, Braşov

CONTROLLER OF PD AND PID FOR A SYSTEM OF ORIENTATION SOLAR PANELS

Marius - Florin BOTIŞ

Transilvania University of Brasov, Department of Civil Engineering

Corresponding author: Botiş Marius-Florin, E-mail: mbotis@unitbv.ro

Abstract: In this paper are presented two controller schemes for control of type PD and PID, which are used for a tracking control. For controlling the solar structure the author uses a dynamic model with one degree of freedom, because after complex analyses, centripetal terms and Coriolis terms that appear in a model with two degrees of freedom, are not so important. The precision of position for solar panels is very important because energetic efficiency for conversion solar energy in electrical energy depend by orientation of solar panels. Controller of type PD and PID are designed in Simulink.

Key words: dynamic model – controller PD and PID – tracking control.

1. INTRODUCTION

In this paper the author presents some aspects about design controller PD and PID for a structure of orientation solar panels. System of orientation solar panels is done for a column on which is put through two cinematic joints a platform with shape like a disk where solar panels are fixed. The disk on which the solar panels are fixed has two degrees of freedom. For action of the whole system on two degrees of freedom we use a hydraulic group which actions two hydraulic motors one rotary and the other linear. The main purpose that disk has two degrees of freedom is to obtain the best energetic conversion of solar energy in electrical energy. One of the problems that occur at the construction of this kind of structure is the transitory response of structure at acceleration and deceleration of system, due to the fact that for one complete movement are necessary, on average, 18 accelerations and decelerations of driving system during one day in the main couple of rotation. Certainly the perturbations from positioning, introduced by inertia, can be corrected by the control system between certain limits. In order to reduce the effect of perturbations, modal and dynamical complex analysis with the programs ETABS and SAP2000 were made. The proper frequencies of elements were chosen so that to deal with rigid body and the structure control can be achieved.

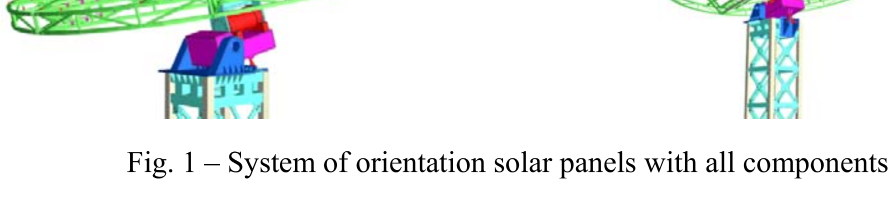
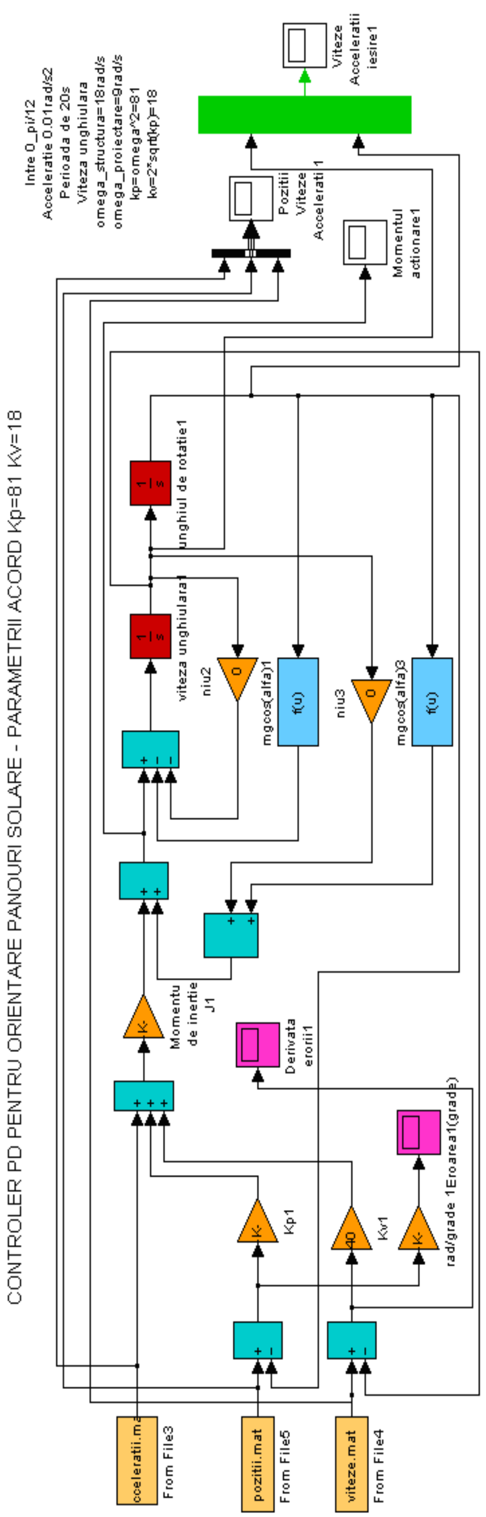


Fig. 1 – System of orientation solar panels with all components



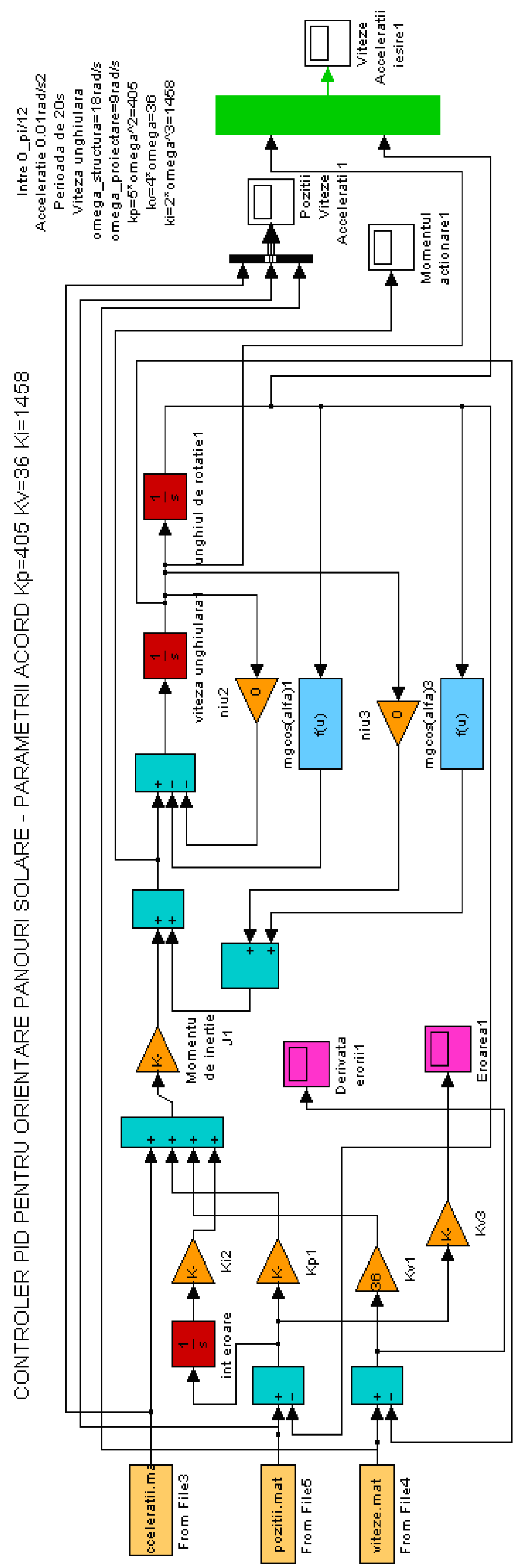


Fig.2 Simulink scheme for design controller PD. Fig.3 Simulink scheme for design controller PID.

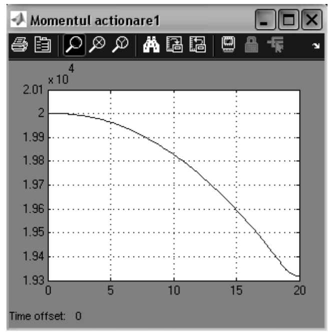


Fig.4 Torque value - controller PD

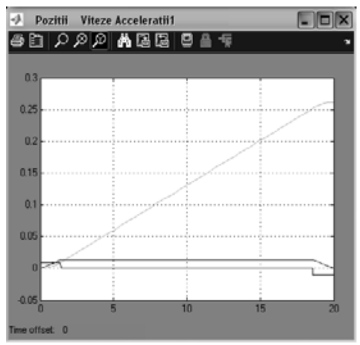


Fig.5 Law for acceleration speed and displacement -controller PD

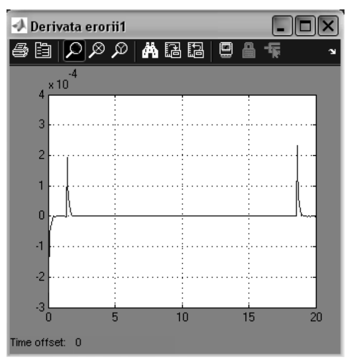


Fig.6 Error derivate for controller PD

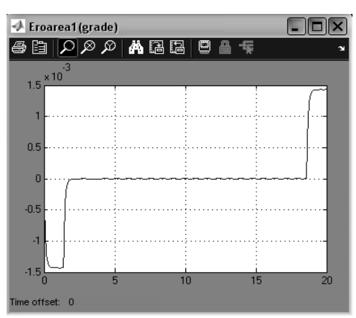


Fig.7 Position error for controller PD

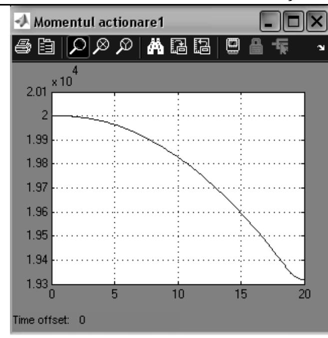


Fig.8 Torque value- controller PID

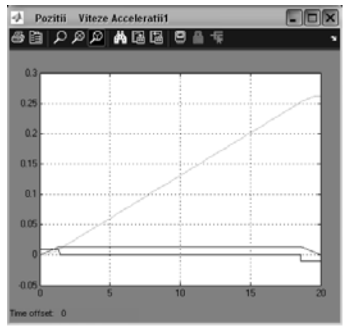


Fig.9 Law for acceleration speed and displacement -controller PID

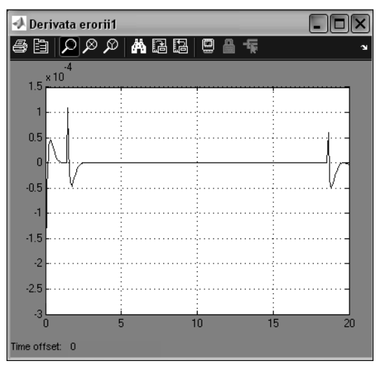


Fig.10 Error derivate for controller PID

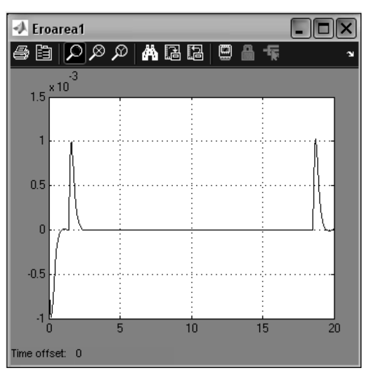


Fig.11 Position error for controller PID

2. DYNAMIC MODEL WITH ONE DEGREE OF FREEDOM FOR SYSTEM OF ORIENTATIONS SOLAR PANELS

For dynamic model in this paper author considers concentrated mass and element of system are considered rigid elements.

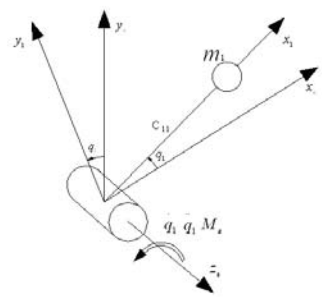


Fig.12–Dynamic model for one degree of freedom (m1=2000Kg, c11=1m)

Cinematic parameters-position angular speed and angular acceleration for mass m1 are:

-position

$$r_1 = \begin{Bmatrix} c_{11} \\ 0 \\ 0 \end{Bmatrix} \quad (1)$$

-angular speed

$$\omega_1 = \begin{Bmatrix} 0 \\ 0 \\ \dot{q}_1 \end{Bmatrix} \quad (2)$$

-velocity for center mass

$$v_{G_1} = \tilde{\omega} r_1 = \begin{bmatrix} 0 & -\dot{q}_1 & 0 \\ \dot{q}_1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{Bmatrix} c_{11} \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} 0 \\ c_{11}\dot{q}_1 \\ 0 \end{Bmatrix} \quad (3)$$

Torque for action structure through Lagrange’ equations is:

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_1}\right) - \frac{\partial L}{\partial q_1} = M_z \quad (4)$$

Torque for action in joint:

$$M_z = \ddot{q}_1 (J_z + m c_{11}^2) - m_1 g c_{11} \cos q_1 \quad (5)$$

The design of control system it means to determine the accord parameters of controller. This process is relatively simple for a SISO (single input single output) system but is more complex for a nonlinear system MIMO (multi inputs multi outputs). Clearly that in the case of MIMO systems the design of controller for a nonlinear system and connected can be equalized with the design of an assembly of controllers associated to nonlinear systems that are not interconnected. The controller design for a linear system is performed by roots place methods and method of transfer function. Practical the problem of a controller design is reduced to determination of the accord parameters of linear systems of second order. More precise the correct placements of the poles of transfer function of a system of second order. For according parameter in case of PD and PID controller :

$$k_V = 2\sqrt{k_P}; k_P = \omega_n^2 \quad (6)$$

$$k_V = 4\omega_n; k_P = 5\omega_n^2; k_i = 2\omega_n^2 \quad (7)$$

3. CONCLUSIONS

-The dynamic model, of Lagrange type, can be used at the control of orientation structures of solar panels being easy to implement, because allows direct achieving of generalized forces from the cinematic couples.

- Due to very high stiffness, of the elements of orientation system can be considered rigid body- without considering their elasticity.

-In order to modeling, from the dynamic point of view, the orientation system behavior can be considered only a model with 1 DOF, because the rotation around Oz axis is performed with very small accelerations which doesn't involve significant inertia forces at very big period of time.

REFERENCES

1. BOTIS, M., *Static and modal analysis of trusses structures,* Napoca Star Publishing House, 2007.
2. OGATA, K, *Modern Control Engineering, Pretince-Hall*, 1977.

Received October 23, 2010