12th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2008, Istanbul, Turkey, 26-30 August, 2008

CONTROLER PID AND PD FOR ACTION A SYSTEM OF ORIENTATION

Marius Botiş
Transilvania University of Braşov – Civil Engineering Faculty
5 Turnului, Braşov
Romania

ABSTRACT
In this paper is presented two controller schemes for control of type PD and PID, which is use for a structure with solar panels (tracking control). For control of solar structure the authors use a dynamic model with one degree of freedom, because after complex analyses, centripetal terms and Coriolis terms that appear in a model with two degree 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 type PD and PID are designed in Simulink.
Keywords: dynamic model, controller PID and PD, tracking control

1. INTRODUCTION
In this paper the author present 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 are fixing solar panels. The disk on which are fixing solar panels have two degree of freedom. For action whole system on two degree of freedom we use an hydraulic group which action two hydraulic motor one rotary and the other linear. The main purpose that disk have two degree 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 that 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 were made modal and dynamical complex analysis with the programs ETABS and SAP2000. The proper frequencies of elements were choused so that to deal with rigid body and the structure control to can be achieved.

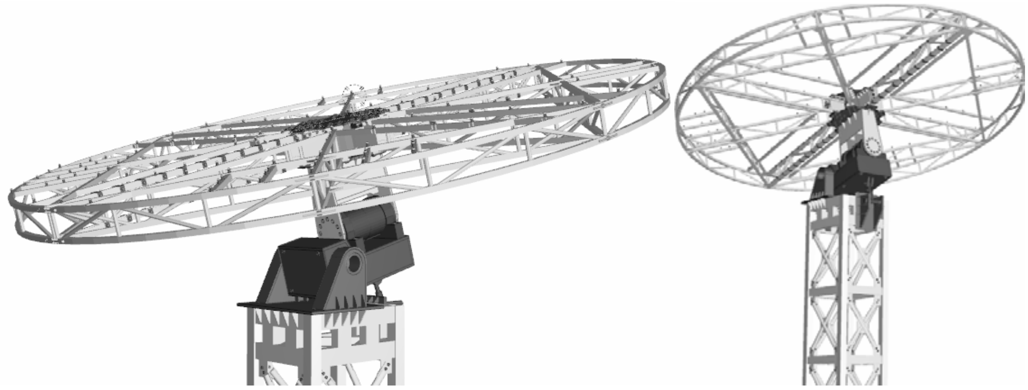

Figure 1. System of orientation solar panels with all components

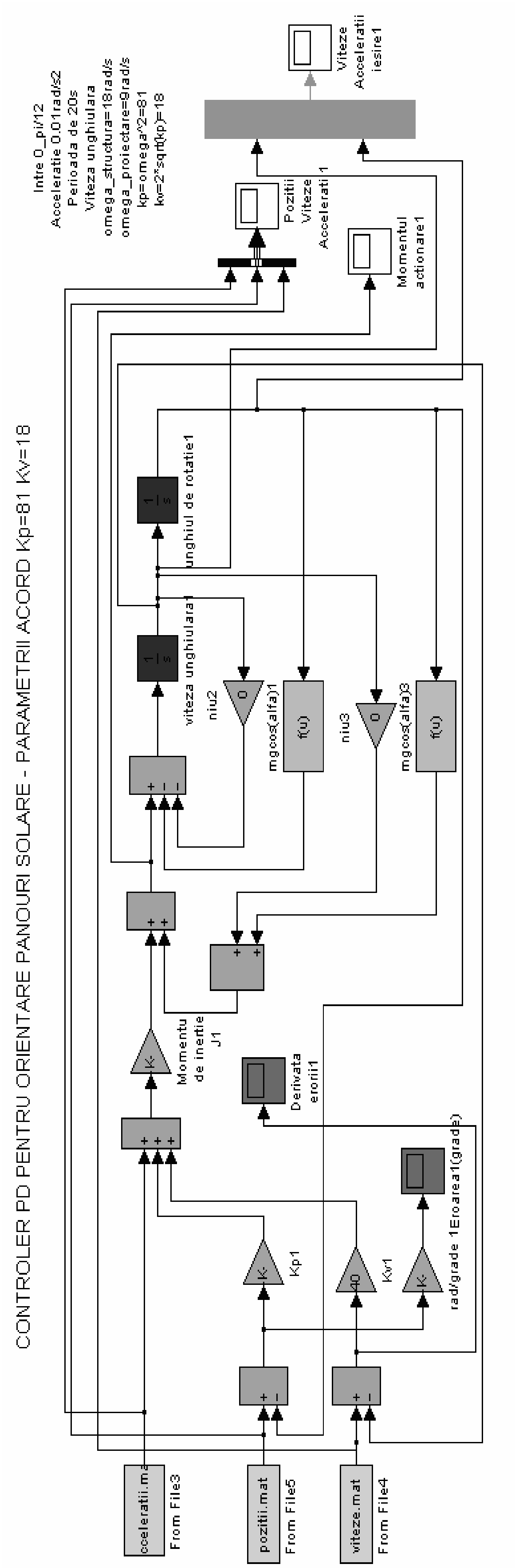

Figure 2. Simulink scheme for design controller PD.

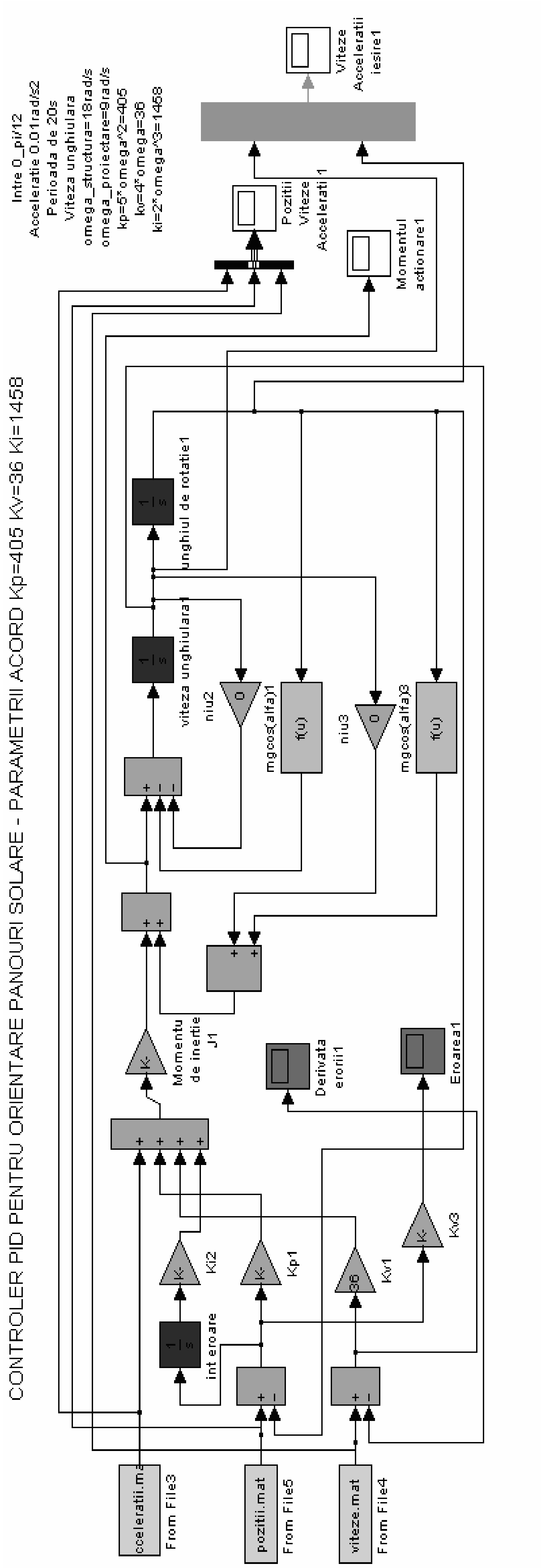

Figure 3. Simulink scheme for design controller PID.

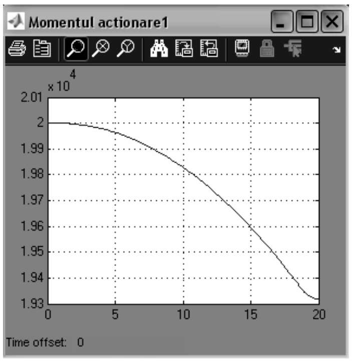

Figure 4.Torque value - controller PD

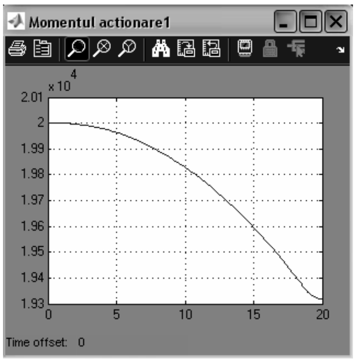

Figure 5. Torque value - controller PID

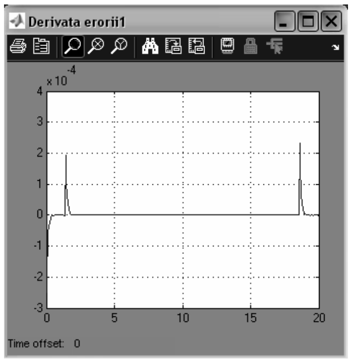

Figure 6. Error derivate for controller PD

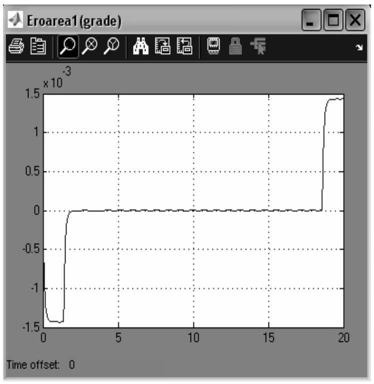

Figure 7. Position error for controller PD

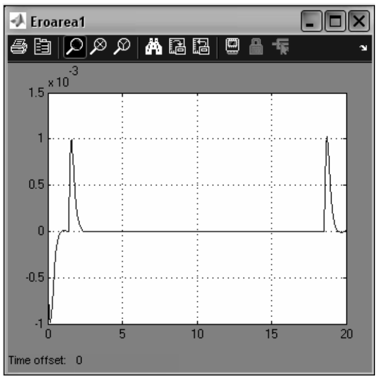

Figure 8. Position error for controller PID

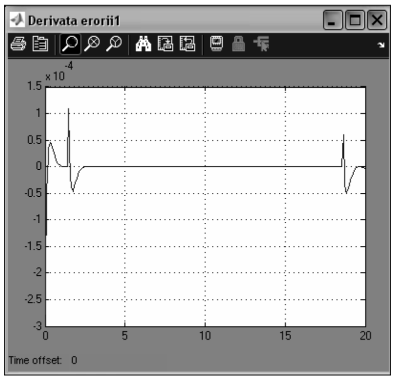

Figure 9. Error derivate for controller PID

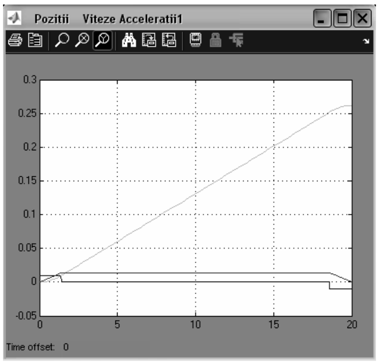

Figure 10. Law for acceleration speed and dispalcement -controller PD

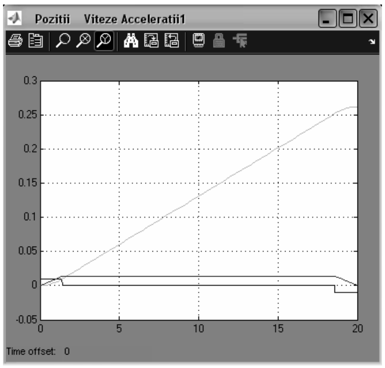

Figure 11. Law for acceleration speed and dispalcemnt -controller PID

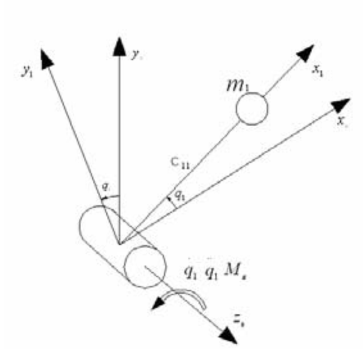

Figure 12. Dynamic model for one degree of freedom (m1=2000Kg, c11=1m)

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

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

Cinematic parameters-position angular speed and angular acceleration for mass m_1 are:

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

-angular speed: $\omega_1 = \begin{Bmatrix} 0 \\ 0 \\ \dot{q}_1 \end{Bmatrix}$ ... (2)

-velocity for center mass: $v_{G_1} = \tilde{\omega} r_1 = \begin{bmatrix} 0 & -\dot{q}_1 & 0 \\ \dot{q}_1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{Bmatrix} c_{11} \\ 0 \\ 0 \end{Bmatrix} = \begin{Bmatrix} 0 \\ c_{11}\dot{q}_1 \\ 0 \end{Bmatrix}$ ... (3)

Torque for action structure through Lagrange' equations is:

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

Torque for action in joint:

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

The drawing 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 drawing of controller for a nonlinear system and connected can be equalized with the drawing of an assembly of controllers associated to nonlinear systems that are not interconnected. The controller drawing for a linear system is performed by roots place methods and method of transfer function. Practical the problem of a controller drawing 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 :

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

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

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. If was used an Newton model than was necessary that initial to determine the dynamic reaction which were not necessary in the control part of the structure.

- 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 dynamic point of view, the orientation system behavior can be considered only a model with 1GLD, 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.

4. REFERENCES

[1] Botis M.: Static and modal analysis of trusses structures, Editura Napoca Star, 2007.,

[2] Ogata K.: Modern Control Engineering, Pretince-Hall, 1997.