Journal of AL-Qadisiyah for computer science and mathematics Vol.10 No.2 Year 2018
ISSN (Print): 2074 – 0204 ISSN (Online): 2521 – 3504

Adaptive feed control of operating tool in Robot machine

Haider A. Abbas Mohammed **Aqeel thamer jawad** **Samah Jalil Saba Khmas**
Diyala University / College of basic education / Computer Department
mr_haider81@yahoo.com

Recived : 20\2\2018 **Revised : 8\3\2018** **Accepted : 14\3\2018**

Available online : 4 /4/2018

DOI: 10.29304/jqcm.2018.10.2.380

abstract :
Adaptive ornate milling technology involves variation of milling operational parameters (particularly, cutter feed speed) based on wood surface texture at the processing spot. It is appropriate to use wood fiber orientation optical recognition method for adaptive ornate milling.
Adaptive milling method is very efficient for ornate milling, when cutter moves along a complex trajectory in space, and feed direction and fibers alignment substantially alters along the trajectory. Moreover, at sharp trajectory sections, adaptive choice of operational parameters permits to materially reduce the chance of wood damaging. Adaptive milling method is most effective for poor value wood that has low stress-strain properties and complex surface structure, so is very prone to damage.

System for programmed PID controller adjustment involves computer with software for certain operating system, input/output hardware and connector cables. Communication with facilities is typically performed by use of OPC server. While adjusting, an object is included in the control loop. The system adjusts and PID controller is registering obtained parameters. Obtained in such way controller parameters will be near optimal due to intuitive user interface, high computer capability and limitless system identification algorithms.

The format in the search shows schematic structure of automated control system of tool feed in adaptive milling, which uses CNC-controlled 3D vertical milling machine, control computer and camera for wood fiber orientation optical recognition, its signal being transferred to milling parameters optimization application.
It should be noted that at such milling with control of supply rate along the complex trajectory of supply of the milling tool, it would be possible to significantly reduce the percentage of shatters. This would allow to significantly reduce economic expenditures for additional operations concerning the surface recovery.

Keyword : Robot machine, OPC server , Proportional Integral Derivative (PID) controller .

Introduction:

The System of program Proportional Integral Derivative (PID) controller adjustment involves computer with software for certain operating system just like input/output hardware and connector cables. Communication could lead to facilities which is typically performed by the use of Open Platform Communications (OPC) server, while adjusting is an object which included in the control loop. The system adjustment and the PID controller are registering that obtained parameters in such a way controller parameters will be near optimal due to intuitive user interface, high computer capability and limitless system identification algorithms.

Figure. 2 shows schematic structure of automated control system of tool feed in adaptive milling, which uses Robot -controlled 3D vertical milling machine, control computer and camera for wood fiber orientation optical recognition. It is a signal being transferred to milling parameters optimization application.

Methods and tools of work

A robot installed is designed as a thermocouple based on the scanning of the wood pieces, the longitude and the latitude of the panels, and through the image to the robot processor on the surface of the panels and the method of linear and longitudinal lines, The process begins with the fossil decoration, where the robot is fed at the required speed, with each wooden line on the surface of the treated board. With the cutting of the longitudinal lines, the robot gives a higher feed rate for the cutter to perform its work. In order to avoid damage and damage to treated panels, In the case of the passage of the cutter on the lines in the opposite way should be less speed cutter larger to avoid the destruction of the plank, during the experiments we took the surfaces of different boards and different rate of moisture to indicate the response of the robot to the treated surfaces, The working tools were a robotic type machine with 4 different types of cutters, shapes and sizes in addition to the depth, wooden boards with different humidity.

Discussion

Adaptive ornate milling technology involves variation of milling operational parameters (particularly, cutter feed speed) based on wood surface texture at the processing spot. It is appropriate to use wood fiber orientation optical recognition method for adaptive ornate milling.

Adaptive milling method is very efficient for ornate milling, when cutter moves along a complex trajectory in space, and feed direction and fibers alignment substantially alters along the trajectory. Moreover, at sharp trajectory sections, adaptive choice of operational parameters permits to materially reduce the chance of wood damaging. Adaptive milling method is most effective for poor value wood that has low stress-strain properties and complex surface structure, so is very prone to damage.

Adaptive milling with operative tool feed control can be implemented by use of self-adapting system see in (Figure 1).

Journal of AL-Qadisiyah for computer science and mathematics Vol.10 No.2 Year 2018
ISSN (Print): 2074 – 0204 ISSN (Online): 2521 – 3504

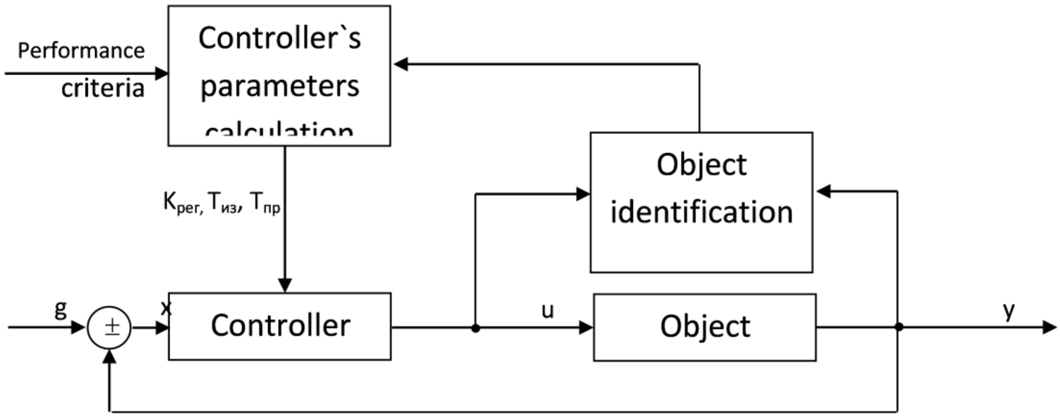

Figure 1 – Schematic structure of adaptive control system

System for programmed PID controller adjustment involves computer with software for certain operating system, input/output hardware and connector cables. Communication with facilities is typically performed by use of OPC server. While adjusting, an object is included in the control loop. The system adjusts and PID controller is registering obtained parameters. Obtained in such way controller parameters will be near optimal due to intuitive user interface, high computer capability and limitless system identification algorithms.

Figure. 2 shows schematic structure of automated control system of tool feed in adaptive milling, which uses Robot-controlled 3D vertical milling machine, control computer and camera for wood fiber orientation optical recognition, its signal being transferred to milling parameters optimization application.

Journal of AL-Qadisiyah for computer science and mathematics Vol.10 No.2 Year 2018
ISSN (Print): 2074 – 0204 ISSN (Online): 2521 – 3504

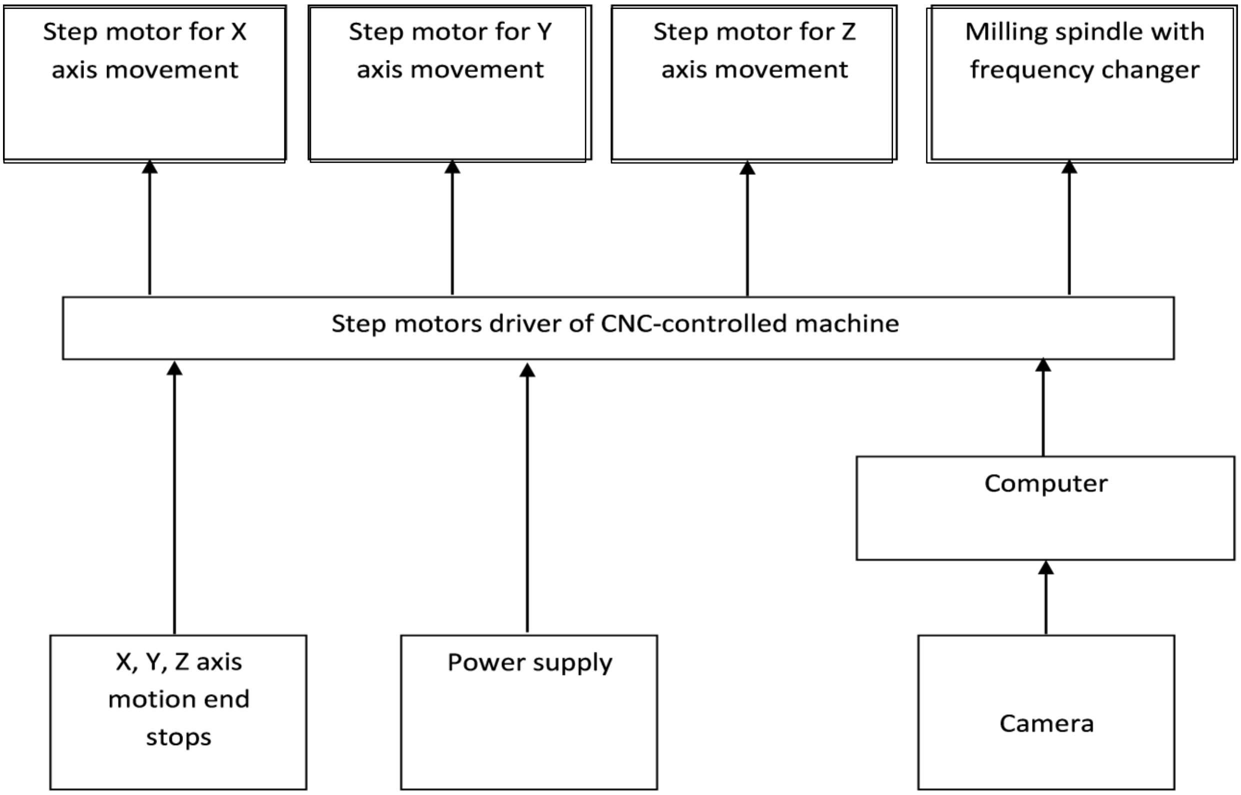

Figure 2 – Schematic structure of automated control system of tool feed in adaptive milling

Adaptive milling effectiveness was investigated in experiments on wood working with variable speed of cutter feed in Robot-controlled machine.

Three wood samples were used: pine, birch, oak with square work contour and variable speed of cutter feed see in (Figure 3).

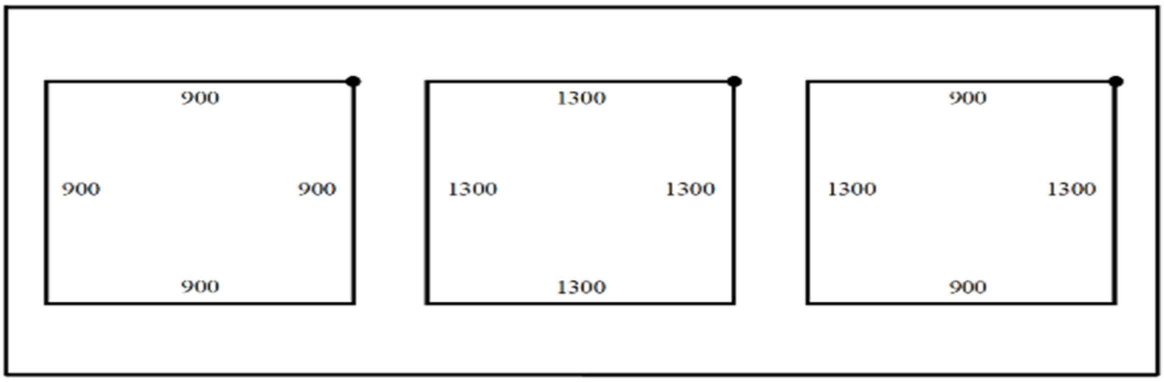

Figure 3 – Milling problem for Robot-controlled machine in experiment on variation of feed speed based on fiber orientation (feed speed is expressed in mm/min while milling pine wood surface)

Milling problem involved coned cutter pass of square contour see in (Figure 4–6). For each timber species milling along the square trajectory was performed in three different ways, based on optimal speeds for length-wise and cross-wise milling, defined during experiments. Square 1 was milled with constant minimal feed speed (in particular, for pine 900 mm/min, see in figure 3). Square 2 was milled with constant maximum (*out of optimum values*) feed speed (for pine 1300 mm/min.). Square 3 was milled with varying speed bearing in mind fiber directions (for pine two sections along fibers were milled at a speed of 900 mm/min, and two sections across fibers – at a speed of 1300 mm/min).

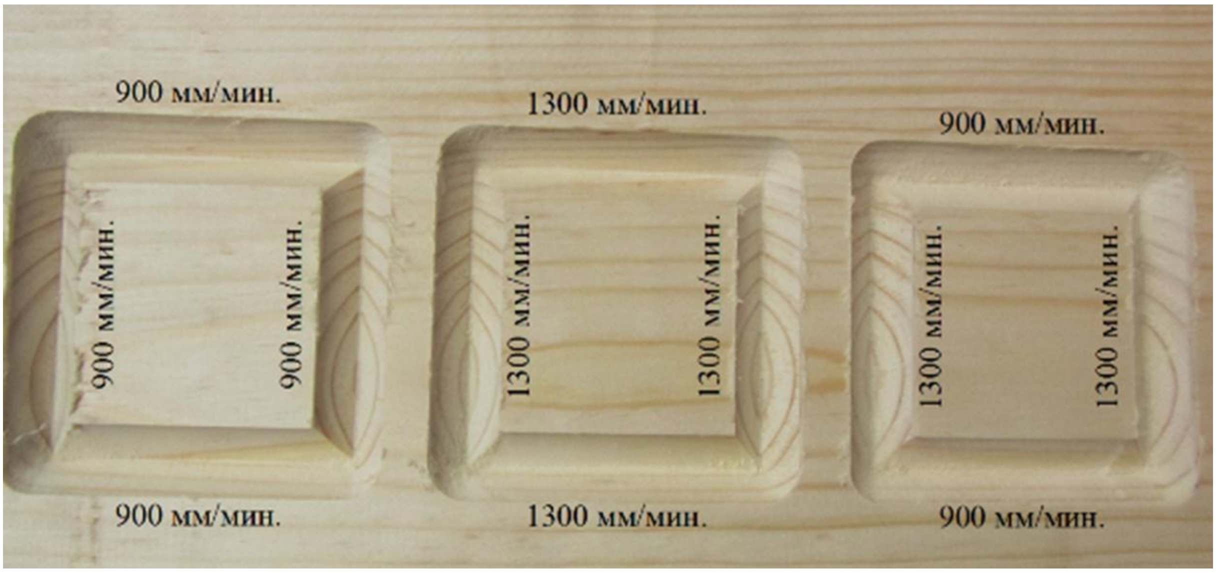

Figure 4 – Result of pine wood surface milling (supply rate along the milling contour sides is indicated in mm/min)

For birch and oak, milling of the first quadrate was also made with the minimum supply rate (1300 mm/min), milling of the second quadrate was made with the maximum supply rate (1700 mm/min), and milling of the third quadrate was made using two supply rate values (1300 and 1700 mm/min), depending on the wood species: for birch, the maximum supply rate of 1700 mm/min was used along the grain, for oak it was used against the grain. *Figures 4–6 show the results of milling of pine, birch and oak wood as per the described procedure.*

After milling, roughness of the twelve parts of the received grooves (the quadrate sides) was measured, and the average roughness value was calculated for each quadrate. Besides, total milling time of each quadrate was calculated based on the used supply rates. The measurement results are given in Table 1 where the cells with roughness and performance values that are the best for particular wood species are darkened.

Journal of AL-Qadisiyah for computer science and mathematics Vol.10 No.2 Year 2018
ISSN (Print): 2074 – 0204 ISSN (Online): 2521 – 3504

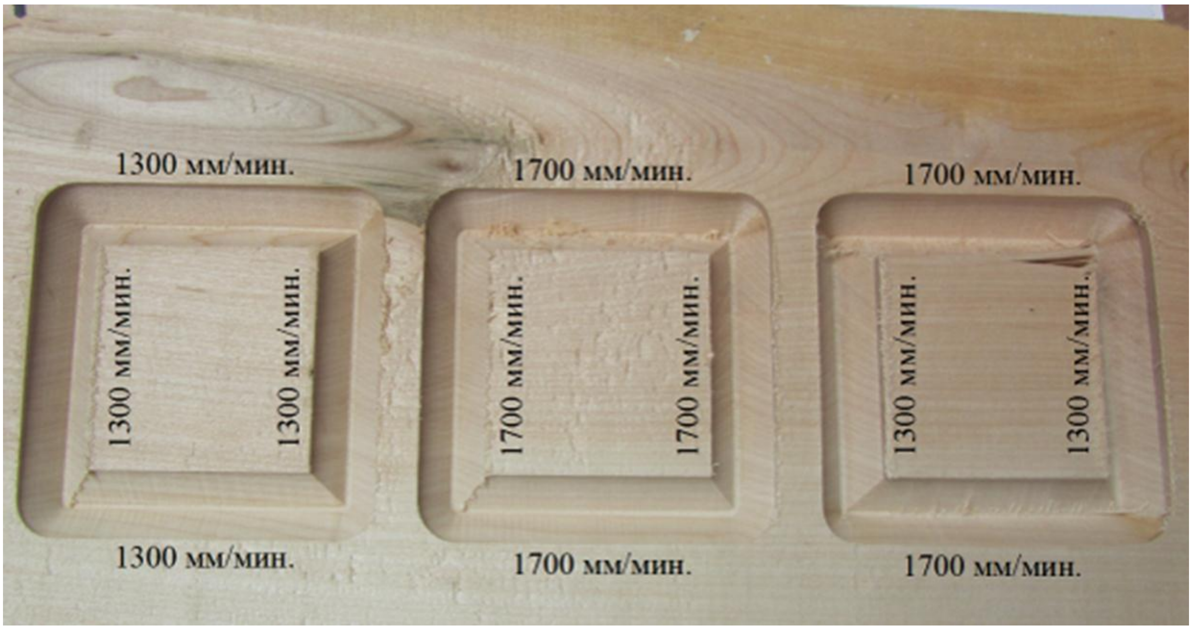

Figure 5 – Result of birch wood surface milling

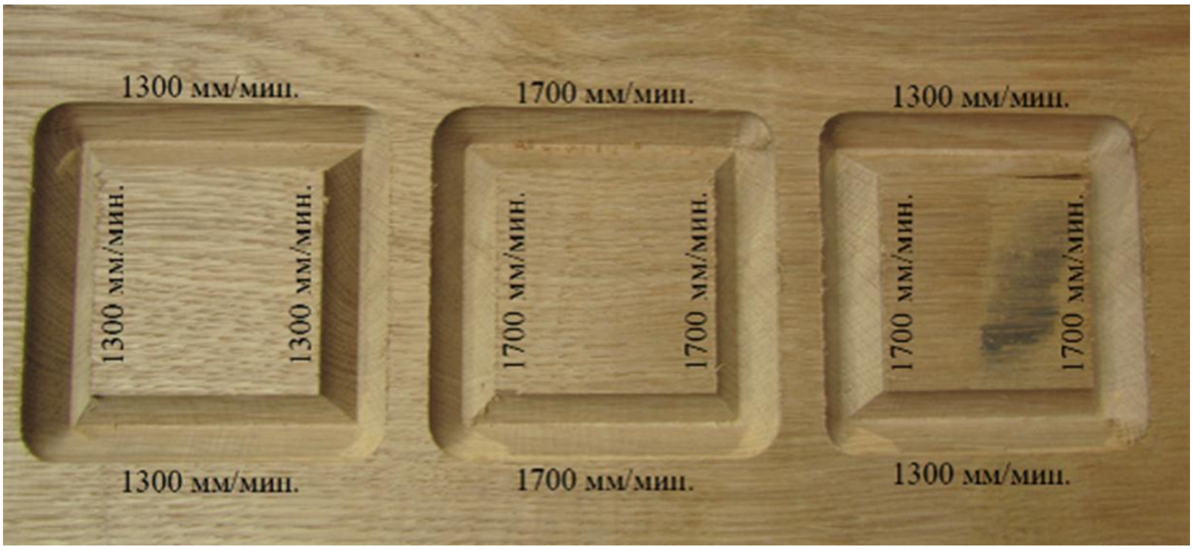

Figure 6 – Result of oak wood surface milling

Table 1 – Milling quality and efficiency with constant and variable rate of supply of the milling tool

Species	Quadrate	Average roughness, micron	Quadrate milling time, s
Pine	left (900 mm/min)	100	26,7
	middle (1300 mm/min)	115	18,4
	right (900 и 1300 mm/min)	85	22,6
Birch	left (1300 mm/min)	85	18,4
	middle (1700 mm/min)	95	14,1
	right (1300 and 1700 mm/min)	80	16,3
Oak	left (1300 mm/min)	115	18,4
	middle (1700 mm/min)	115	14,1
	right (1300 and 1700 mm/min)	110	16,3

Based on the review of the received results, the following conclusions can be made. If milling is made with lower supply rate (the left quadrate), high roughness values (due to the areas for which such supply rate is not optimal) and much time of the quadrate milling are received. If milling is made with higher supply rate (the middle quadrate), high roughness values (also due to the areas for which such supply rate is not optimal) and little time of the quadrate milling (that is positive) are received.

In regards to roughness reduction, the best alternative is the use of variable supply rate depending on the grain direction (the right quadrate). In this case, roughness is minimum, in particular, while milling pine, roughness is 18–35 % less than while milling with the constant supply rate. At this, time of milling of the quadrate is quite little in comparison with the cases with constant supply rate. Moreover, at the place of production,

lower supply rate is usually used, it is why acceleration of supply in separate areas results in significant increase in efficiency (in this case, by 23 % for pine).

For birch and oak, the use of variable supply rate also results in the reduction of roughness, in comparison with the constant supply rate, however, in a less degree (by 19 % and 5 % respectively).

It should be noted that at such milling with control of supply rate along the complex trajectory of supply of the milling tool, it would be possible to significantly reduce the percentage of shatters. This would allow to significantly reduce economic expenditures for additional operations concerning the surface recovery.

Conclusion:

Thus, in the process of adaptive milling of wood, taking into account direction of grain allows to reduce roughness, time of part processing and possibility of unacceptable surface damage.

Technology of adaptive milling can be used, in the first place, by small businesses, with small-batch and job-order production of furniture decorative fixtures. Under working conditions of these enterprises, there is no possibility to select mill conditions by experiment, as it is done at large furniture enterprises with large-batch orders.

References

1. Lera D., Sergeev Ya.D. (Acceleration of univariate global optimization algorithms working with Lipschitz functions and Lipchitz first derivatives) // SIAM Journal on Optimization. 2013. Vol. 23, no. 1. P. 508-529. DOI: 10.1137/110859129

2. Birgin E.G., Martínez J.M., Prudente L.F. (Augmented Lagrangians with possible infeasibil-ity and finite termination for global nonlinear programming) // Journal of Global Optimization. 2014. Vol. 58, no. 2. P. 207-242. DOI: 10.1007/s10898-013-0039-0

3. Karpenko A.P., Shurov D.L. (Hybrid method of global optimization based on an artificial immune system)/ M .: science and education, 2012.

4. Voglis C., Parsopoulos K.E., Papageorgiou D.G., Lagaris I.E., Vrahatis M.N. MEMPSODE: (A global optimization software based on hybridization of population-based algorithms and local searches) // Computer Physics Communications. 2012. Vol. 183, no. 2. P. 1139-1154. DOI: 10.1016/j.cpc.2012.01.010

5. Źilinskas A., Źilinskas J. A (hybrid global optimization algorithm for non-linear least squares regression) // Journal of Global Optimization. 2013. Vol. 56, no. 2. P. 265-277. DOI: 10.1007/s10898-011-9840-9

6. Luz E.F.P., Becceneri J.C., de Campos Velho H.F. (A new multi-particle collision algorithm for optimization in a high performance environment) // Journal of Computational Interdisci-plinary Sciences. 2008. Vol. 1, no. 1. P. 3-10. DOI: 10.6062/jcis.2008.01.01.0001

7. Rios-Coelho A.C., Sacco W.F., (Henderson N. A Metropolis algorithm combined with Hooke-Jeeves local search method applied to global optimization) // Applied Mathematics and Computation. 2010. Vol. 217, no. 2. P. 843-853. DOI: 10.1016/j.amc.2010.06.027

Journal of AL-Qadisiyah for computer science and mathematics Vol.10 No.2 Year 2018
ISSN (Print): 2074 – 0204 ISSN (Online): 2521 – 3504

التحكم في تغذية أدوات العمل في ألة روبوت

حيدر عبدالباقي عباس محمد

عقيل ثامر جواد

سماح جليل سبع

كلية التربية الاساسية/ جامعة ديالى

المستخلص:

يتضمن نظام ضبط وحدة التحكم (PID) برنامج كمبيوتر مع برمجيات نظام تشغيل معينة ، تماما مثل أجهزة الإدخال / الإخراج وكابلات الموصل ، الاتصالات يمكن أن تؤدي إلى التسهيلات التي يتم تنفيذها عادة من قبل استخدام خادمOPC ، في حين التوافق هو الكائن الذي يشتمل في حلقة نظام التحكم. توافق النظام ومنسق ال (PID) هو التسجيل التام للحصول عليه من البارامیتر بطريقة تكون قريبة من الاوبتيمل نتيجة لبديهية واجهة المستخدم، كومبيوترات عليه القدرة و خوارزميات تحديد نظام لا حدود لها.

كلمات مفتاحية: الة روبوت ، خادم OPC، وحدة التحكم (PID)