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Design Get up System Surface Height Setting Fluid Use Control Adaptive Type Self Tuning Regulator

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ABSTRACT

A system is adaptive in a way general means is capable of system changes in an environment that doesn't predict, which arises in the system or outside the system. In planning use control, aside have to adapt to changing environments, too capable adapting error or uncertainty design techniques that are not always thorough, and capable of compensating for error components to be more system stable, so the reliability system will increase. Generally, system dynamic (active and moving) has no parameters of course it's a constant or parameter not of course that has changed over time. For arranging system dynamics more appropriate If used control adaptive. At the moment Already Enough Lots type system arrangement adaptive is or chosen by existing plants. Every type of arrangement adaptive has a method certain in the finish problem settings used. A type of arrangement adaptive Possible will by certain plants that are regulated, but not necessarily will in accordance for arrange other plants. For That need exists suitability between type arrangement adaptive used with regulated plants. In research this is designed system arrangement of tall surface liquid with interaction use arrangement adaptive type Self Tuning Regulator (STR). Research result This shows that convergency estimation of control parameters with the use method square smallest recursive (recursive least square) occurs in the 2nd sampling period ten and so on (bigger or the same with ten) and happens oscillations on each beginning sampling (T<10 Seconds). This shows that parameter estimates yet produce previous parameter values. From the results curve transient (Figure 3 to 6) be seen that the output of the adaptive system is very close to the desired system output. A real difference seen at the start caused iteration Because the estimation of system parameters not yet get close results with actual system parameters. However, after iteration certain systems adaptive This can produce output that is very close to the desired system output.

Keywords: Control Adaptive, Self-Tuning Regulator, Plant, Parameters

INTRODUCTION

System Arrangement Adaptive Identification Model

System Arrangement Adaptive Identification Model also called Self Tuning Regulator (STR) System. In control system adaptive, assumed that the regulator parameters are set For every hose time (Ogata.K., 1987) (Ogata.K., 1970). Generally, the regulator parameters are always changed during the process (Erwin., 2016) (Ibrahim., 2002) (Fadhil., 2019). In a system self-tuning regulator, there are difficulty in analyzing characteristics or characteristics convergence and stability from the system. To simplify the problem system control, then We assume that the process has constant parameters and is not known. Controller adaptive is generally convergent or stable if the process has process-constant parameter values and not is known (Syarif., 2007) (Yuqin.W., 2021).

Self-Tuning Regulator (STR) in its implementation done separation results parameter estimates are not known from the designed controller (Astrom., 1995) (Astrom., 1990). Where parameters are not known This will be estimated on-line (continously) using a recursive estimation method. For overcome parameters no of course on the system dynamic is by using parameter estimation viz with estimating parameter price of measurement system input-output signals. Parameter estimation can be done online or offline. Estimation is done offline If the parameters are constant and available Enough time For estimating these parameters. However, for the parameters the that price changes during operation, then that is necessary is estimate online for setting parameter price. Because the problem in arrangement adaptive usually includes price parameters changed every time, the method estimation online will be more good and relevant.

Following This can be seen a block diagram from *the self-tuning regulator*:

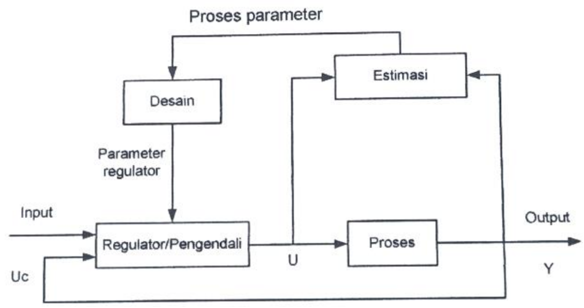

Figure 1: ***Self-Tuning Regulator Block Diagram***

Figure 1 presents the *online* process of something problem design system with known parameters. Operation of the settings *self-tuning regulator* is as follows:

Block diagram consists of two loops, namely the first loop or the inner loop that consists of the process and controller (regulator) and the second loop or outer loop is the defining loop price of the inner loop parameters on each moment estimator (estimator) sends one set price parameter estimation to the controller (regulator), this set obtainable from the calculation of input U or output Y moment previously. This data is by computer and then processed or processed so that the obtained U controller input signal. New U controller input This causes new plant output generated and cycled on repeatedly (continuously) (Bernard., 1985) (Fitriyanto., 2011).

Design System

In research this is designed system arrangement of tall surface liquid with interaction use arrangement adaptive type *Self Tuning Regulator* (*STR*). Surface height fluid with interaction This consists of two parts mutual vessels related as in Figure 2.

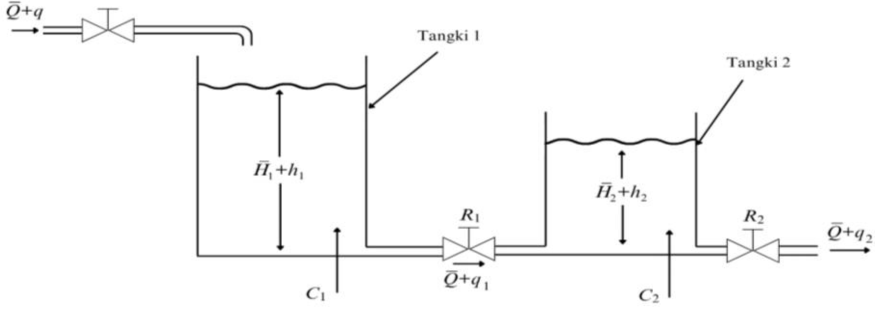

Figure 2: Surface Height System Fluid with Interaction

Figure 2 obtains obtained equality system as follows:

$(h_1-h_2)/R_1= q_1$ (1)

$C_1 (dh_1/dt) = q-q_1$ (2)

$H_2 / R_2 = q_2$ (3)

$C_2 (dh_2/dt) = q_1-q_2$ (4)

If q is input and q_2 is output, then the function switch system is:

$$\frac{Q_2(s)}{Q(s)} = \frac{1}{R_1C_1R_2C_2s^2 + (R_1C_1 + R_2C_2 + R_2C_1)\, s + 1} \quad (5)$$

In simulation for example system parameter values fluid is: R_1 (Detention Genre fluid 1) = 5 sec/m^2, R_2 (Resistance Genre fluid 2) = 4 sec/m^2, C_1 (Tank capacity 1) = 3 m^2, C_2 (Tank capacity 2) = 2 m^2. Furthermore, by entering the parameter value into equation 5, the system transfer function becomes,

$$G(s) = \frac{Q_2(s)}{Q(s)} = \frac{1}{120.s^2 + 35.s + 1} \quad (6)$$

The system arrangement adaptive used is STR type so the system will be implemented (Equation 6) is carried out Transformation Z, and for time 1 second sampling, obtained:

$$G(z) = \frac{0{,}61z + 0{,}57}{z^2 - 1{,}821z + 0{,}781} \quad (7)$$

If it is assumed z=q then equation (7) becomes,

$$G(q) = \frac{B}{A} = \frac{0{,}61q + 0{,}57}{q^2 - 1{,}821q + 0{,}781} \quad (8)$$

Even more so from equation (8), polynomials A and B are as follows,

$A= q^2 + a_1 q + a_2$ and $B= b_o q + b_1$ (9)

Equality equation (8) and equation (9), are obtained values: $a_1 = -1{,}821$, $a_2 = 0{,}781$, $b_o = 0{,}61$,
and $b_1 = 0{,}57$

In the simulation for system forget closed as desired own mark natural frequency $\omega_n = 0.6$ rad/sec and coefficient damping $\xi = 0.4$ as well pole value $S_{1.2} = -0.6 \pm 0.917j$ then the transfer function is,

$$T(s) = \frac{1}{s^2 + 1{,}2.s + 0{,}84} \quad (10)$$

and to period 1 second sampling is obtained,

$$T(z) = \frac{0{,}41z + 0{,}275}{z^2 - 0{,}812z + 0{,}381} \quad (11)$$

Let z= q, then equation (11) becomes,

$$T(q) = \frac{0{,}41q + 0{,}275}{q^2 - 0{,}812q + 0{,}381} \quad (12)$$

And in the matter of This, for example, mark or price the *observer polynomial* is,

$A_o = (q - 0{,}4)^2 = q^2 - 0{,}8q + 0{,}16$ (13)

Where the polynomial observer function does estimation or identification control parameters.

Design Controller

In research this, the method controller used is *pole* placement without zero removal.

Another formulation of equation 8 is,

$$G(q) = \frac{Yq}{Uq} = \frac{0{,}61q + 0{,}57}{q^2 - 1{,}821q + 0{,}781} \quad (14)$$

Even more so with The Back Transformation Z in equation 14 obtained the system output equation is as follows,

$Y_{(n)} = 0{,}61U_{(n-1)} + 0{,}57U_{(n-2)} - 1{,}821Y_{(n-1)} - 0{,}781Y_{(n-2)}$ (15)

MATERIALS & METHODS

In research steps taken are as follows:

1. Identify characteristics of dynamic plants. To identify characteristics of plant dynamics from the system, one must do testing and analyze the results from testing. Identification can be done using normal operating data from the plant or a test signal like a sinusoidal signal.
2. In identifying a plant, time must be short Possible compared to with the rate of change around him. This is done to avoid changing variations of parameters in the plant. Picking decisions based on plant identification. Once the plant is identified, then the result is compared to with optimal characteristics, The next decision on how parameters can be arranged must change for optimal performance. this decision is usually taken with the help computer.
3. Do modifications or give signal mover based on decisions that have been made.
4. Lower transfer function because existence from something system stated with function transfer. The transfer function has been lowered and entered in

the blocking process, because of the process of *self-tuning the regulator* This is recursive, then the transfer function of the system desired closed-*loop* transformed from domain 's' to domain 'z'.

Do an estimation to get a set of matching parameters with plant inputs. Process estimation here states the estimator, where the estimator is a component important in the regulatory process adaptive system *self-tuning* regulator. Process This is a method of parameter estimation gradually based on input (input) and output (output) behavior. With the hope in time furthermore will achieve condition desired output the same as the process output. The estimator used in the system *self-tuning regulator* is the Kalman Estimator. The Kalman Estimator is used to estimate the *least square* (square smallest). In matter, This Kalman Estimator is a discrete estimator that will carry out the estimation process in a way recursive.

RESULT

Simulation Results

Research result in This done simulation for a known response controller adaptive for input in the form of ladder units (*unit steps)* for some sampling time value (*time sampling*) (Antonius., 2006) (Ane., 2008).

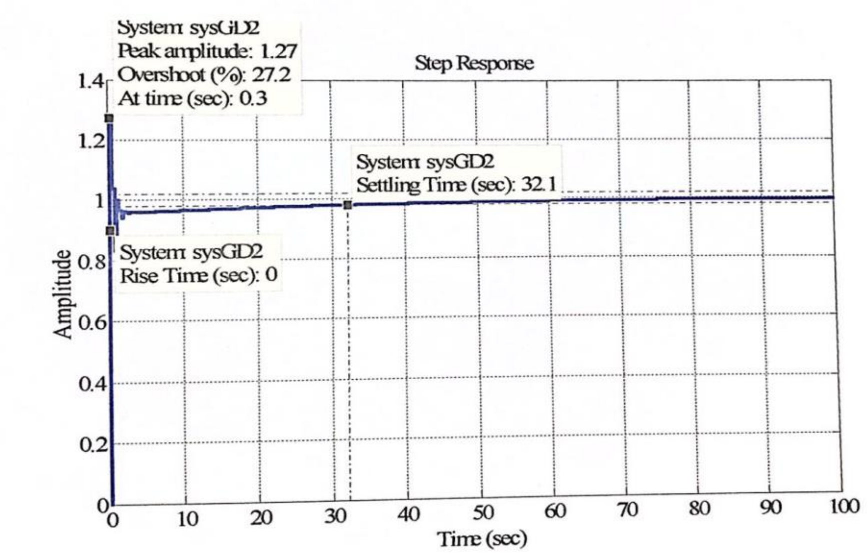

Figure 3: Response Step Controller Adaptive With a Time Sampling of 0.3 Seconds

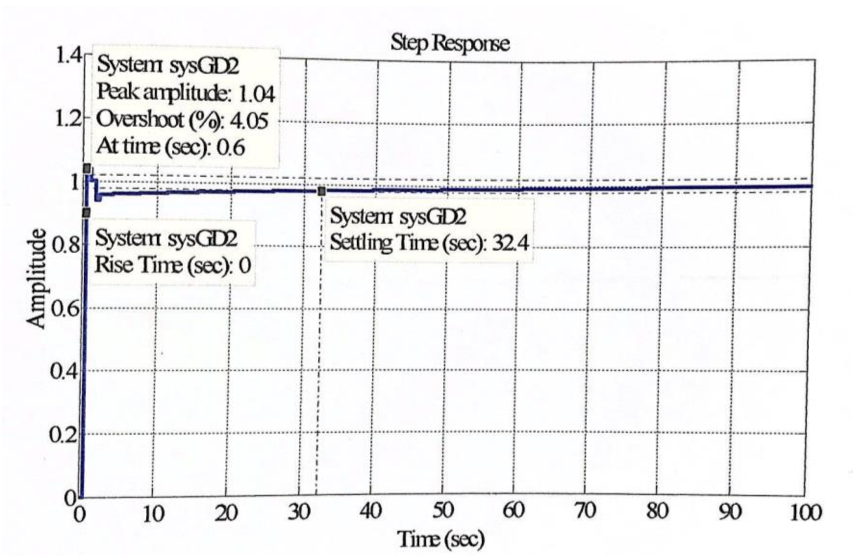

Figure 4: Response Step Controller Adaptive With a Time Sampling of 0.6 Seconds

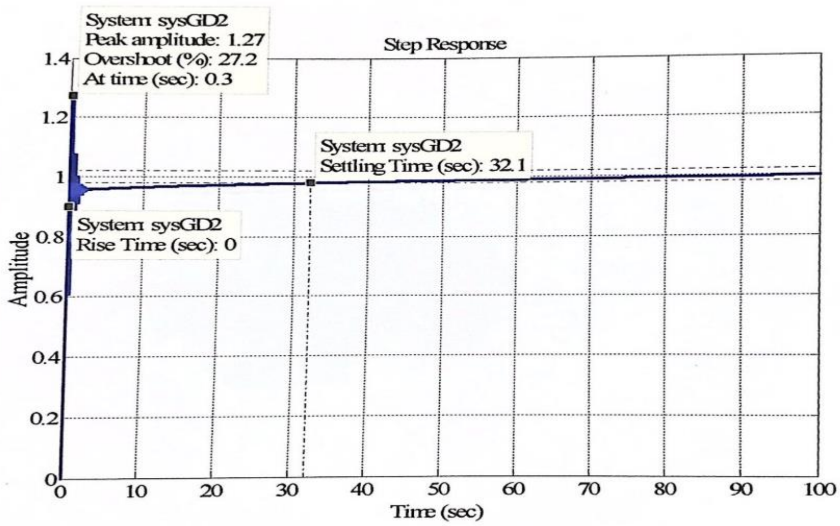

Figure 5: Response Step Controller Adaptive With a Time Sampling of 0.2 Seconds

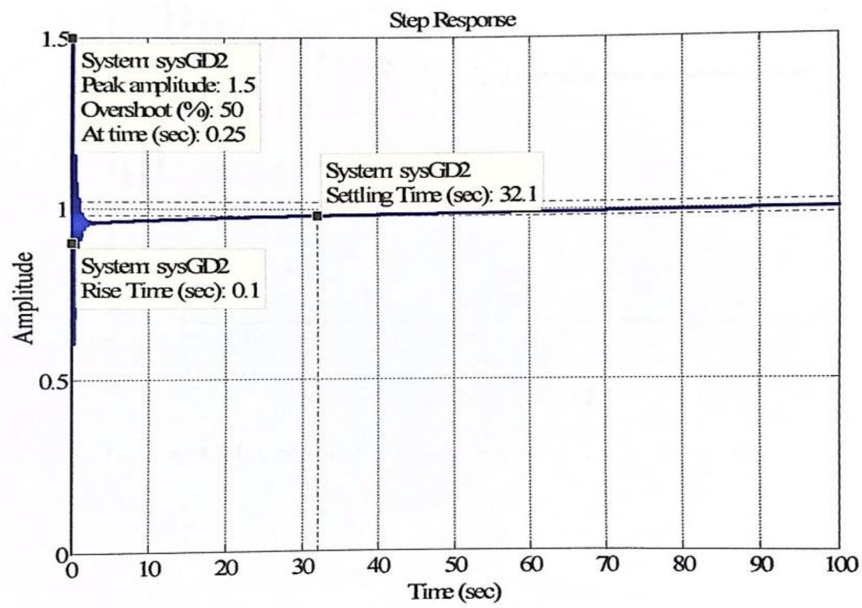

Figure 6: Response Step Controller Adaptive With a Time Sampling of 0.1 Seconds

DISCUSSION

Analysis

Control Model Parameter Estimation

The results testing show that convergence estimation of control parameters uses the method square smallest (*least squares*) relatively faster. Observation shows that the average convergence occurred during *sampling* to ten or afterward.

Important thing about utilization method square smallest recursive (*least square recursive*) in do estimating of control model parameters is election mark beginning. From the results observation seen that election values beginning these and prices factor abandoner can result in behavior from signal control and output varies the shape. And result observation shows that visible oscillations in each test generally happen to everyone beginning sampling period. This matter shows that parameter estimates yet produce actual parameter values.

Response system with system *closed loop* as desired i.e. 1 / [s^2+1,2s+0,84] in the system adaptive with function over, and y is response system adaptive with *indirect self-tuning regulator*. From the graph obtained seen that the system output adaptive is very close to the desired system output. A real difference seen at the start caused iteration because the estimation of system parameters did Not yet get close results with actual system parameters. However, after iteration certain systems have adaptive, meaning the system can produce output that is very close to the desired system output.

Pole Placement Control Without Eliminate Zero

The results testing signals u controller with the use of controller *pole placement*, obtained from the chart from signals u controller without existing oscillations that are not desired. This matter is caused because in planning its control no use method zero deletion.

CONCLUSION

Based on the results of the simulations and analyses carried out, can take several conclusions as follows:

1. Planning system control adaptive can be done with two steps main one is modeling controlled systems and designing the controller alone.
2. There are several method modeling controls, one method used in the study is with estimates (identification) in a way numeric that is with method square smallest recursive (recursive least square). With this method system model parameters that have not yet been determined are known, but only with observed signal input and output.
3. The process of estimating control model parameters in a way numeric possible monitoring control parameters online (cont continuously). And ability This leads to the utilization of draft system control adaptive control in controller design.
4. With closed loop form (loop closed) which is stable so will obtain some results of the estimates that will converge on the value actually what you get from the calculation of the plant.
5. Simulation carried out from results design or research design This shows that convergence estimation of control parameters with the use method square smallest recursive (recursive least square) occurs in the 2nd sampling period ten and so on (bigger or the same with ten) and happens oscillations on each initial sampling (T<10 Seconds). This shows that parameter estimates yet produce previous parameter values

Declaration by Authors

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REFERENCES

1. Astrom, K. J. and B. Wittenmark," Adaptive Control 2nd ed.", USA Addison-Wesley Publishing Company, Inc.1995.
2. Astrom, K. J. and B. Wittenmark," Theory and Design,2nd ed", USA: Addison -Wesley Publishing Company, Inc.,1990.
3. Antonius. W. N, Karnoto, Trias. A," Simulasi Implementasi Self Tuning Regulator Pada Model Sistem Pembangkit Listrik Mikrohidro Untuk Pengendalian Frekuensi Keluaran Generator Dengan Menggunakan Matlab 6.1", Makalah Seminar Tugas Akhir, Universitas Sriwijaya,2006.
4. Ane. P. R, Ridwan. G," Pengendalian Adaptif Fuzzy Untuk Self Tuning PI Kontrol kecepatan Motor Induksi Tiga Fasa Tanpa Sensor Kecepatan Degan Observer MRAS", Fakultas Teknik, Universitas Indonesia,2008.
5. Bernard Widrow and Samuel. D Stearns," Adaptive Signal Processing" Prentice-Hall, Inc.,1985.
6. Erwin. I, Tri. K. P, Edi. S," Sistem Kendali Adaptif Neuro-Fuzzy PID Pada Kapal Katamaran Tanpa Awak", Jurnal Teknika STTKD, Vol.3, No.2, Desember 2016.
7. Ibrahim Nawawi," Implementasi persamaan Diopanthin Pada Sistem Kendali Adaptif Skema Self Tuning regulator", Vol.32, No.2, Agustus 2002, https://media.neliti.com
8. Muhammad Fadhil Al-Arif," Perancangan Kendali Adaptif STR-PID Untuk Pengendalian Posisi Pada Sistem Magnetic Levitation Ball",Program Studi Teknik Elektro, Fakultas Sains dan Teknologi, UIN

Sultan Syarif Kasim Riu-Pekanbaru, Desember 2019.
9. Muhammad Fitriyanto," Aplikasi Kendali Adaptif Pada pengendalian Plant Pengatur Suhu Dengan Self Tuning Regulator (STR)", Jurusan Teknik Elektro, Fakultas Teknik, Universitas Diponegoro Semarang, Januari 2011.
10. Muhammad Syarif, Iksal," Simulasi Kendali Adaptif Untuk Kestabilan Tinggi Permukaan Cairan", Tugas Akhir Jurusan Teknik Elektro ST. INTEN Bandung,2007.
11. Ogata. K," Discrete Time Control Systems", Prentice-Hall., Englewood Cliffs, N.J,1987.
12. Ogata. K," Modern Control Engineering", Prentice-Hall., Englewood Cliffs, N.J,1970.
13. Yuqin. W, Haodong. Z, Zhibo. H, Xiaoqiang. Ni," Perancangan Optimasi Sistem Kendali Aliran Pompa Sentrifugal Berbasis kendali Adaptif", Sekolah Teknik Mesin, Universitas Chaohu,Agustus 2021.

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