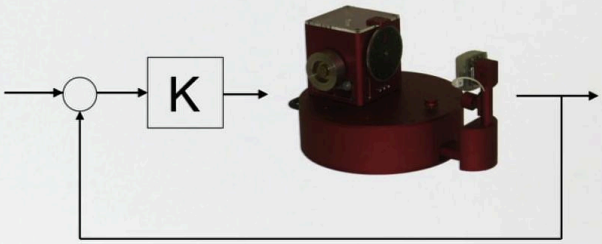


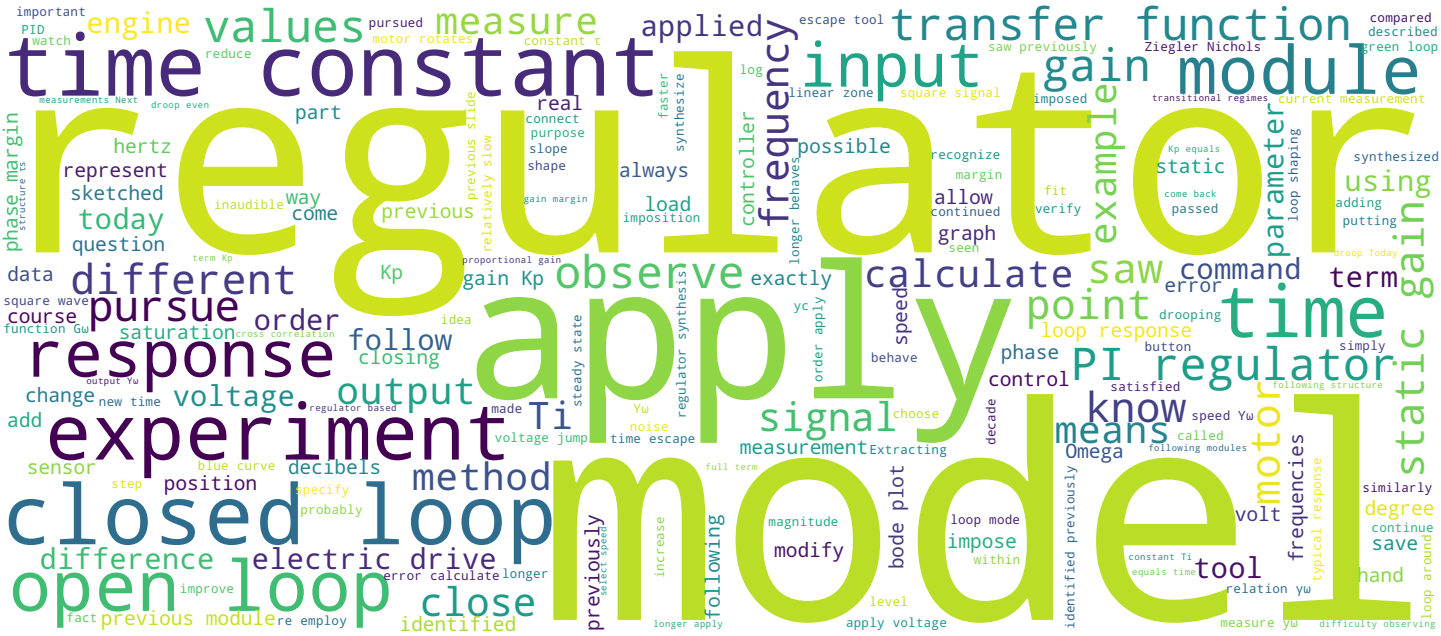
Synthèse du régulateur

Contrôle en vitesse avec imposition du modèle à poursuivre

Controls Systems' Hand on Sessions

Christophe Salzmann & Colin Jones

Automatic Control Lab



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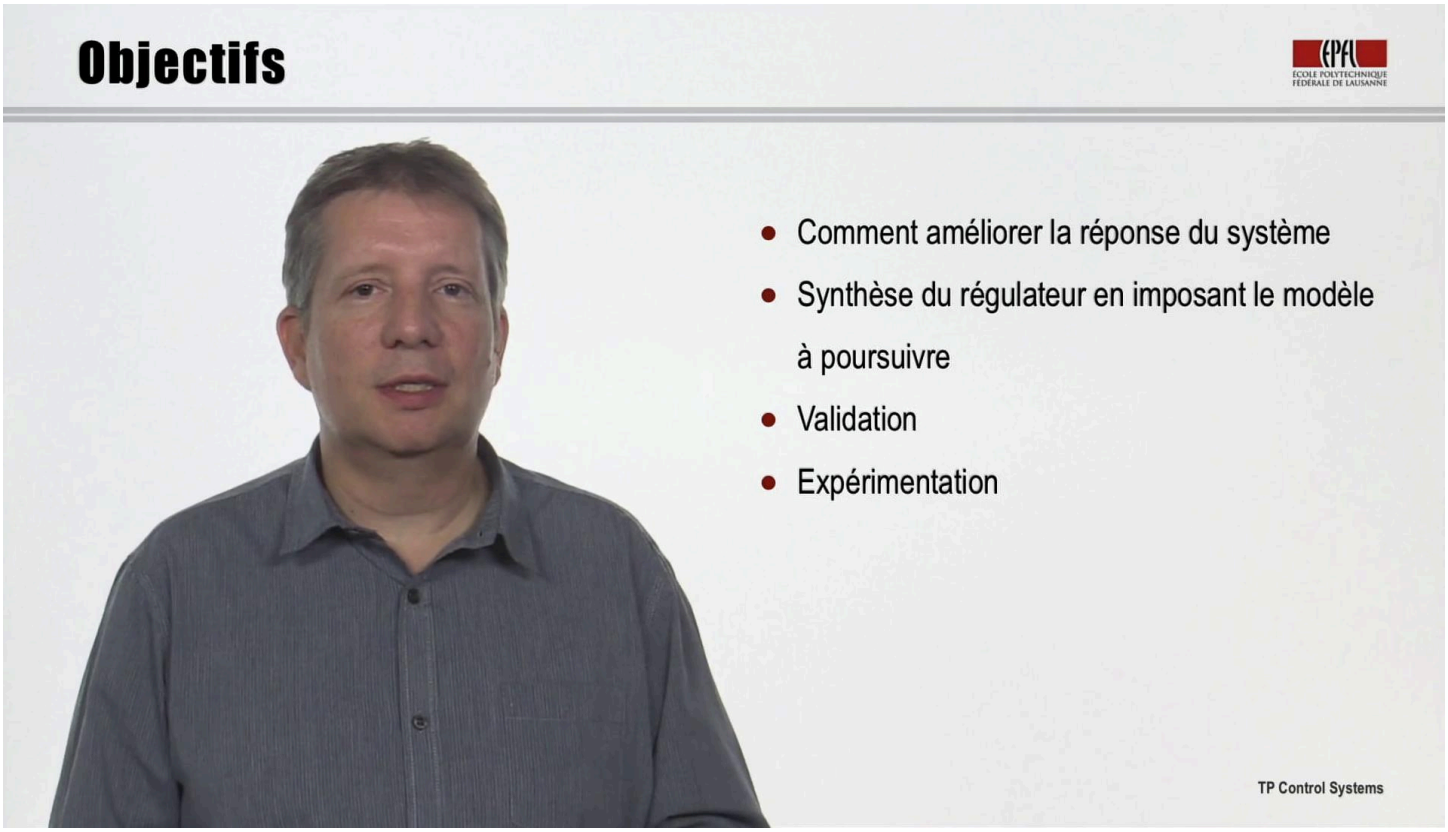


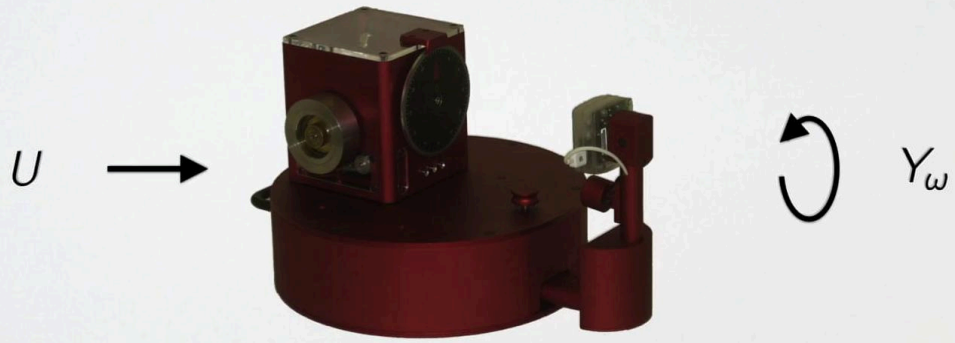
Bonjour, In this module, we will see how to improve the response of an open loop system this using a regulator by closing the loop. We will see how we will synthesize this regulator. In this module, we will use a method which is called the imposition of the model to pursue, then we will do some experiments with the regulator that we synthesized.

Notes

Summary

0m 04s

Entraînement électrique



TP Control Systems

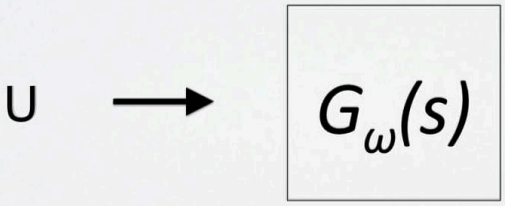
We will use the same electric drive as in the previous modules where we apply voltage to the motor, the motor rotates at a speed Yω.

Notes

Summary

0m 22s

Fonction de transfert en boucle ouverte



$$G_\omega(s) = \frac{\gamma_\omega}{\tau s + 1}$$

gain statique

cst. de temps

TP Control Systems

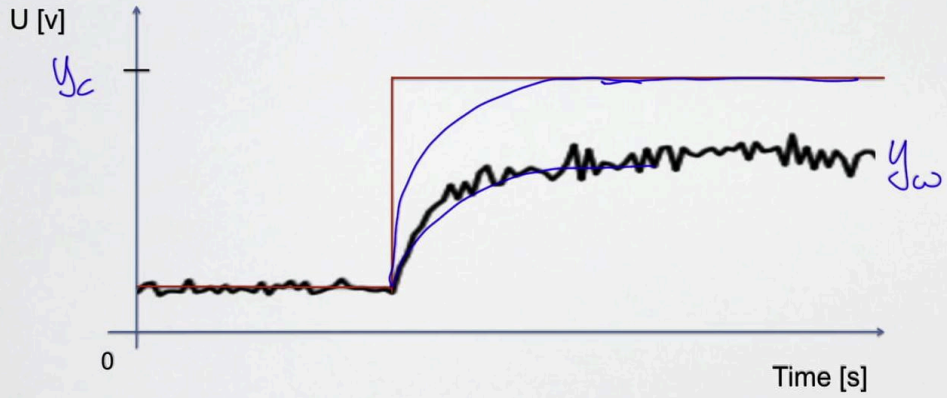
We saw that this engine could be described through a transfer function, this transfer function Gω of S is given by the relation γω which represents the static gain of the system and the time constant τ of our system. These two values were identified during the previous module and we will re-employ them for this module.

Notes

Summary

0m 36s

Amélioration de la réponse



TP Control Systems

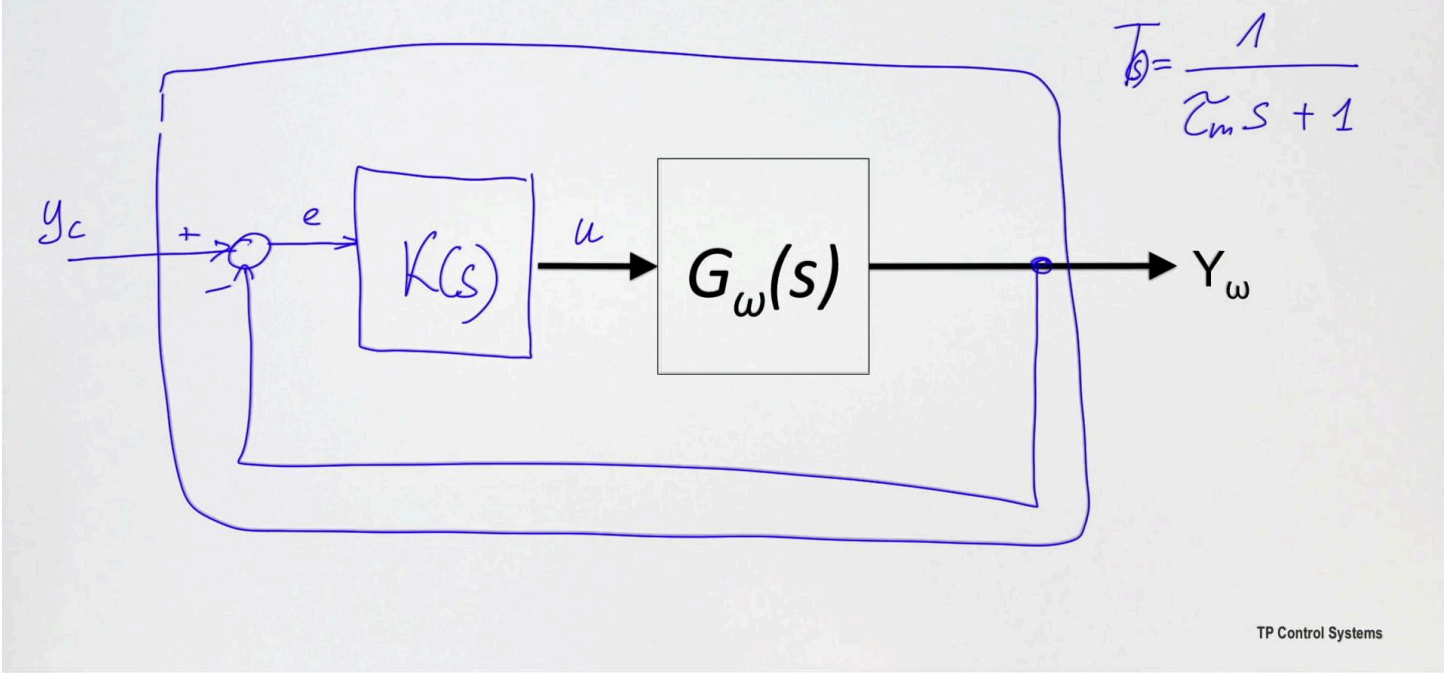
On this graph, I have represented the level that I was going to apply on the system and here we see the typical response of the open loop system. Here we have the system measure yω. On the other hand, what we would like is firstly that our value yω is really close to the set value which I applied to my system, and similarly here, we see that the time constant on my system is relatively slow. For example, I would like to be able to speed it up so that it is faster. The question is how to change the system so that it no longer behaves like a green loop, but like the blue curve that I sketched on this graph.

Notes

Summary

1m 08s

Modèle à poursuivre



TP Control Systems

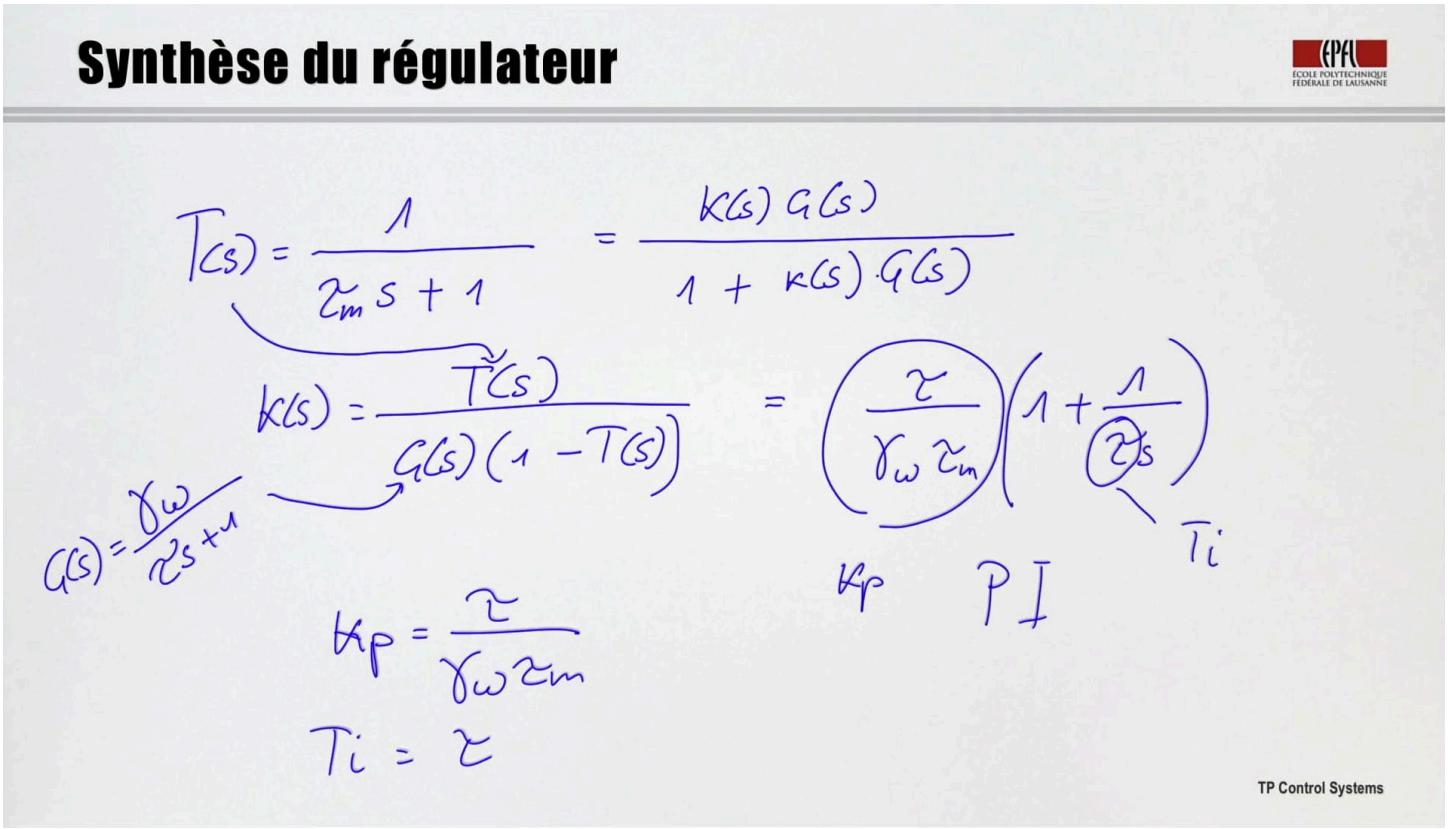
The idea is to close the loop around of my electric drive which is here in open loop. So, I'm going to add a regulator to my system. This regulator will apply a command to my system. For my regulator, I will apply the input value here, the set value which will be compared to the current measurement of my engine. The difference between the two will be the error, my regulator will take this error, calculate an order, apply it to the system and thus we will be able to close the loop. What we would like to have, is that the closed loop system that we have here behaves like the system that I sketched on the previous one and this system is given by the following equation: T of s is equal to my new time constant plus 1, here, we see that I have a static gain of 1, this means that once the transitional regimes have passed, there is no longer any difference between the output Yω and yc. T de s is a model to pursue, I know G de s, now how to find K of s?

Notes

Summary

1m 48s

Synthèse du régulateur



So, I come back with my model to continue T of s 1 on a time constant, I would like this to be equal to my closed loop that we saw previously so the closed loop is K of s plus G of s. Extracting K from my system, I find that if now, I know G of s from the previous slide where we had G of s which is equal to the static gain over the time constant plus 1, so I can come and apply it here, my T of s, I find it here. By putting T of s and G of s in my equation, I finally find that my time constant... Finally, I find here the following structure τs and you will recognize here a PI regulator where here we see the term Kp and here my time constant Ti. So you now have Kp equals time on [inaudible 00:04:53]. And my Ti which is equal to the constant. You now have the gain Kp and the full term of your PI regulator based on the values you identified previously and the value that we would like to have for the model to pursue.

Notes

Summary

3m 18s

Validation

- Calculez K_p et T_i pour le modèle à poursuivre
  $T(s) = \frac{1}{\tau_m s+1}$ avec $\tau_m = 0.1s$
- Connectez-vous à l'expérience à distance
- Sélectionnez le mode **vitesse** et **boucle fermée**
- Appliquez un saut de tension dans la zone linéaire
- Sauvez les mesures
- Utilisez l'outil de fit temporel pour vérifier que la réponse en boucle fermée suive le modèle à poursuivre

TP Control Systems

So now it will be up to you to calculate your PI regulator. You will calculate the gain Kp and the Ti for a model to pursue with a time constant of zero one second. You will then log in to the system, you will select speed and closed loop mode, very important, you will apply a voltage jump in the linear zone, Once you are satisfied with the system response, you will save your measurements. Next, you will use the time escape tool to verify that the closed loop response of your system follows the model to be pursued that you have imposed.

Notes

Summary

5m 17s

Expérimentation 1 – Statisme

En boucle fermée, avec le régulateur PI calculé précédemment

- Appliquez un signal **carré** entre 2 [v] et 3 [v], avec une fréquence de 0.1 [Hz]
- Observez s'il y a du statisme/trainée

TP Control Systems

The purpose of this first experiment is to see if you have drooping in a closed loop with your PI regulator. To do this, you will apply a square wave to your system with a frequency of 0.1 hertz and you will watch the response of your system and see if there is any static.

Notes

Summary

5m 54s

Expérimentation 2 – Statisme

Avec le régulateur PI calculé précédemment

- Appliquez une **rampe** entre 2 [v] et 3 [v], avec une fréquence de 0.1 [Hz]
- Observez s'il y a du statisme/trainée

- Réduire K_p à 0.5
- Observez s'il y a du statisme/trainée

TP Control Systems

In this second experiment, this time you will no longer apply a square signal, but it always falls within the same values and you will observe if there is any static. You will probably have difficulty observing this droop even if it is there. So to be able to observe it, you will reduce the gain of your Kp regulator to 0.5. And this time you should observe the droop.

Notes

Summary

6m 10s

Conclusions

Qu'ai-je appris aujourd'hui ?

- La réponse d'un système en boucle ouverte peut être modifiée en fermant la boucle et en ajoutant un régulateur
- Le régulateur peut être spécifié de sorte que le système en boucle fermée suive un modèle à poursuivre

TP Control Systems

Today we saw that it is possible to modify the open loop response of a system this by closing the loop and adding a regulator. One of the ways to specify this regulator, it is to impose the closed loop model which must follow a model to be continued. In the following modules, we will see other methods of regulator synthesis.

Notes

Summary

6m 33s