Commande - Diagnostic des pannes - Automatique

Composante
ENSPIMA

Présentation

Code interne : AP9SYCDA

Description

Objectifs / Compétences acquises
Stochastic processes: understand the definition of a random signal and its basic properties learn the first and second order characterization tools (expectation, correlation functions) spectral analysis learn the properties of well-known stochastic processes (white noise, autoregressive processes)
Digital control systems: understand the basic concepts of designing a numerical control algorithm understand the principles of parametric model identification from measured input-output data discover the main model structures learn the principles of model validation
Fault detection and isolation: understand the concept and benefits of fault detection in aerospace applications acquire a basic knowledge on model-based fault detection and isolation methods acquire the methodological and mathematical tools for designing a fault detection algorithm via the parity space approach
Compétences en cours d'acquisition
Intégrer les dimensions financières, juridiques et contractuelles dans sa pratique de l'ingénierie
Compétences niveau maitrise encadrée
Avoir une approche globale systémique Raisonner dans un contexte de contraintes réglementaires internationales
Anticiper, décider en situation d'incertitude Etre orienté résultats (coûts, délais, qualité) et satisfaction clients
Evaluer ses propres compétences et piloter sa trajectoire professionnelle
Compétences niveau maitrise autonome
Mobiliser un large champ de sciences fondamentales et techniques lié aux systèmes avioniques et spatiaux, et avoir la capacité d'analyse et de synthèse qui leur est associée
Identifier les systèmes embarqués dans un aéronef, les systèmes de commande, de mesure et les protocoles de communication associés
Identifier les systèmes de radiofréquence communiquant avec un aéronef et les caractéristiques des signaux utilisés
Concevoir, dimensionner, réaliser et tester un dépannage/modification d'un système embarqué dans un aéronef
Communiquer et travailler en équipe Piloter et animer une unité de travail ou un groupe projet
S'intégrer dans un environnement professionnel en France ou à l'international Communiquer à l'écrit et à l'oral en anglais

Pré-requis obligatoires

Good knowledge of transfer function, continuous time control and frequency response of dynamical systems is needed. Basic knowledge of multivariable control and working knowledge of Matlab/Simulink are also necessary

Syllabus

Contenu
Stochastic processes
The objective of this course is to introduce stochastic processes and their properties. After recalling the tools to study random variables and vectors, we extend the latter to infinite collections of random variables, i.e. random signals. We then present how to analyze the time-evolution of these random signals by means of correlation functions. Building upon this notion, power spectral densities are presented for the frequency domain analysis. Finally, we focus on well-known stochastic processes such as white noises, colored noises and autoregressive processes
Digital control systems
The first part of this course introduces the basic elements of a computer-controlled system as the ones that can be found in the aerospace field and shows the negative effects that can appear if the specificities of these systems are not taken into account during the control law design. We then present the design of robust digital RST controllers with two degrees of freedom by sensitivity functions shaping in the frequency domain
The second part of the course presents the parametric model identification for dynamic systems. We start by introducing the concept of linear regression model to establish a relationship between a dependent variable and one or more explanatory variables. The Least Squares (LS) method is proposed to estimate the parameters of these models by minimizing a quadratic criterion. This method gives unbiased results under some conditions only in the case on systems disturbed by zero mean Gaussian disturbances (also known as white noise). To overcome this limitation, recursive identification methods are proposed for models in the ARMAX class. The last part of the course discusses the validation of the identified models
Fault detection and isolation
This class is intended to provide students with an overview of fault detection and isolation methods used in aerospace applications. A focus is provided regarding model-based approaches. The general idea is to compute a fault indicator signal (called residual signal) from the signals available in the flight control unit (measure and control signals). This residual signal is then evaluated in order to determine a fault occurrence, generate an alarm and localize the faulty component. Main method studied in the class is called the parity space approach
Méthode pédagogique d'acquisition
These courses are entirely taught in English
The lessons from these courses will be delivered in the form of integrated courses using Matlab-Simulink. The concepts studied during these courses will be put into practice during the pedagogic projects of semester 10
All course material will be available on the Moodle platform

Informations complémentaires

Spécialisation : Systèmes aéronautiques

Modalités de contrôle des connaissances

Évaluation initiale / Session principale - Épreuves

Type d'évaluation	Nature de l'épreuve	Durée (en minutes)	Nombre d'épreuves	Coefficient de l'épreuve	Note éliminatoire de l'épreuve	Remarques
Contrôle Continu	Contrôle Continu			0.1		
Epreuve Terminale	Ecrit	120		0.25		sans document
Epreuve Terminale	Ecrit	120		0.35		sans document
Epreuve Terminale	Ecrit	120		0.3		sans document

Seconde chance / Session de rattrapage - Épreuves

Type d'évaluation	Nature de l'épreuve	Durée (en minutes)	Nombre d'épreuves	Coefficient de l'épreuve	Note éliminatoire de l'épreuve	Remarques
Epreuve terminale	Ecrit	120		0.35		sans document
Epreuve terminale	Ecrit	120		0.35		sans document
Epreuve terminale	Ecrit	120		0.3		sans document

Infos pratiques

Contacts

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