2SC5894 – Design and analysis of production systems for smart factories

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Department: DOMINANTE - INFORMATIQUE ET NUMÉRIQUE
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
Recent developments in manufacturing engineering lead to the formulation of dedicated new paradigms such as Industry 4.0 (Germany) and smart manufacturing (USA). The main idea behind these novel paradigms is that future production systems shall be capable to fullfil individual customer requirements by flexibly adapting the production outcome so to yield product variants in very small lot size. To this aim manufacturing systems must become "smart" hence consisting of intelligent machines, pieces and infrastuctures able to exchange and process information so that the production process adapts itself to the specific customer requirements. In this context modelling and performance analysis of production processes becomes fundamental. In this course we are going to focus on formal modelling and performance analysis of production processes whereby a number of fault-prone machines are arranged in a given topology to yield a given final product. We are going to analyse how relevant performance indicators are affected by different aspects of the production systems and so to study the impact that system's (re)configuration has on productivity.

Quarter number
ST5

Prerequisites (in terms of CS courses)
Students must have attended the course "Systèmes critiques" of ST5

Grading
Seminar

Resources
A tutorial room with WiFi connection

Learning outcomes covered on the course

Students will learn how to apply formal methods to the problem of modelling and performance analysis of a production system, i.e. a system composed by a network of fault-affected, repairable manufacturing machines that can be configurated adaptibly in response to market needs.

- developping stochastic models of production systems starting from a informal specifications
- taking into account fault injections in the production system model
- conception of relevant key performance indicators for analysing the performances of the production system (fault tolerance, availability, throughput, etc)
- execution of a complete performance analysis study based on model checking approaches

Description of the skills acquired at the end of the course

see "learning outcomes"

ST5 – 59 – ASSISTANCE AND AUTONOMY OF THE PERSON

Dominante : VSE (Living-Health-Environment) and ENE (Energy)
Langue d'enseignement : French
Campus où le cours est proposé : Metz

Engineering problem

This thematic sequence deals with the design of motorized assistance systems for people with reduced mobility, whatever their nature, in its technical, economic and ergonomic aspects. This issue, which has a strong societal impact, is at the heart of two concerns. Firstly, the ageing of the population is increasing the need for this type of system. In addition, due to the evolution of low-cost on-board computer systems, it is now possible to offer increasingly complex functionalities, allowing the spectrum of services provided to be broadened, ranging from motor servoing to more advanced control (trajectory calculation, obstacle avoidance) or even connected and communicating systems.

For example, a very common device nowadays is the wheelchair to help people with reduced mobility (paralysis of the legs). These chairs can be simply mechanical or electrically assisted. Reimbursed by the social security, they are medical devices subject to approval.

Beyond the technical problems, one must also consider the cost (in France the price is fixed by the social security) and the ergonomics. Experiments are taking place on systems that could be different, such as exoskeletons.

Adviced prerequisites

None

Context and issue modules: this part is structured in conferences and round table allowing to apprehend the problematic, the technologies and the stakes of the devices related to the person:
- Environment, type of pathology, manual and electric wheelchairs. Homologation
- How to improve people's lives
- Demonstration of wheelchairs, technological locks, innovation

Specific course (60 HEE): *Control of a motorization chain*

Short description : This course deals with the notions necessary for the control of a motorization chain in its electronic aspects (converters, power,

supply), servo control (modeling, observers, regulators) and digital (analog-digital conversion, programming, real time). The practical aspects will be tested on microcontroller boards in order to implement a speed control system for a DC motor.

Challenge Week : *Design of a motorized wheelchair for people with reduced mobility*

Associated partner: Logosilver Company, CERAH (Center for Study and Research on the Fitting of the Handicapped)

- **Location:** Metz campus

- **Brief description :** A wheelchair for a person with reduced mobility must ensure a minimum level of safety set by standards. Mechanical design and motor control work together to achieve this safety. The confrontation of the students with the normative and security aspects at the same time as with the mechanical and electronic/computer technical aspects opens them to the multidisciplinary dimension. The specificity of this integration course is the consideration of safety in technical designs. In addition, as current trends are for all objects to be increasingly "connected", functions of this type will be considered (steering the chair from a smartphone, steering the house from the chair, etc.).

This integration course is designed to lead to the concrete realization of a wheelchair. The whole is a mini-project sequenced in individual thematic sessions (mechanics, electronics, computer science, automation...). The themes can be variable according to the groups of students (not all groups do all the themes) and will follow a schedule allowing to arrive at the end at an operational chair.