2EL6210 – Geopolitics of resources and objects

Instructors: Raphael Danino-Perraud
Department: CAMPUS DE RENNES
Language of instruction: FRANCAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Business Sciences
Advanced level : No

Description

In their future careers as engineers, CentraleSupélec students will be called upon to place their practices in globalized economic and political worlds. These are characterized by the interconnection of different parts of the globe and an intensification of the flow of capital, goods and services on a global scale, made possible in particular by the development of means of transportation and information and communication technologies. Although globalized production and exchange networks appear to be free of all material constraints, they remain highly dependent on natural resources and technical objects.

Since the end of the 20th century, human activities and their impacts (urbanization, climatic and environmental changes) have contributed to increasing the pressure on resources and their availability. The geopolitics of resources and objects influences international power relations and raises power issues at various scales (local, national, regional, global).

To understand the stakes of our globalized political and economic system, we must therefore adopt a critical reading of techniques and resources. To do so, we adopt a perspective centered on a certain number of resources (mining, agricultural and energy, but also waste) and infrastructures (pipeline, electrical network, hydroelectric dam). It is from these geopolitical themes that students will be led to identify the power relationships between actors and the economic stakes associated with them.

Quarter number
SG6

Prerequisites (in terms of CS courses)

None

Syllabus

Detailed course outline (content): 11 sessions of 3h, 1 exam of 1h30
Session 1 - Introduction: a brief epistemology of resources - Raphaël Danino-Perraud and Angélique Palle (TD)
Session 2 - A transnational energy transport infrastructure as a geopolitical object - Noémie Rebière (CM)
Session 3 - Methodology of geopolitical mapping - Léa Gobin and Noémie Rebière (lab)
Session 4 - Geopolitical impacts induced by the energy transition: risks on objects and resources circulation - Angélique Palle (CM)
Session 5 - Project support - Raphael Danino-Perraud and David Juilien (PT)
Session 6 - Applied exercise: role-playing - Wahel Rashid and David Juilien (PT)
Session 7 - Producing and feeding ourselves: conflicts over resources - Matthieu Brun (CM)
Session 8 - Hydroelectric dams, a geopolitical object - David Juilien and Wahel Rashid (TD)
Session 9 - Mineral raw materials, globalized resources: the example of lithium - Audrey Sérandour (CM)
Session 10 - Waste, a geopolitical object - Wahel Rashid and Raphaël Danino-Perraud (TD)
Session 11 - The contrasting application of the duty of care for resources and conclusion of the course - Raphaël Danino-Perraud (CM)
Session 12 - Homework (1h30)

Class components (lecture, labs, etc.)

Grading

Student learning will be assessed in two ways:

1. A cartographic analysis file, carried out in groups (of 3-4 students) equivalent to 50% of the grade.
Throughout the sequence, students will have to build a geopolitical reflection around a resource or a globalized object. They will have to identify the main actors and issues raised by this resource or object, take a critical look at the materiality of the resources and techniques studied (no technology is neutral) and construct a reflection at different scales (global, regional, national, local).
Based on a bibliographic research, students will have to produce two analytical maps presenting a geopolitical reasoning around a globalized resource or object. At least one of the two maps must be produced on a

global scale. The supervision of this work will begin during the session on the methodology of geopolitical cartography (session 3), then we will have a session dedicated to the accompaniment of projects (session 5). The restitution will take the form of a written file, including the two maps, a description of the problematized legend (in 1 page) and an analysis of the maps (in 5 pages maximum). This written report will be graded.
Follow-up on the project will be organized during the semester through presentations on the state of the art (not graded).

2. A table-top assignment, carried out in session 12 (duration: 1h30) equivalent to 50% of the grade.
This will consist of a commentary on documents (a corpus composed of excerpts from articles, a map and a graph). The corpus will present a case study, which will be analyzed by mobilizing the concepts studied in class.

Course support, bibliography

- ABIS Sébastien, BRUN Matthieu (2020), « Géopolitique de l'agriculture européenne », Études, 2020/2 (Février), pp. 17-28.
- LACOSTE Yves (2008), « La géographie, la géopolitique et le raisonnement géographique », Hérodote, 2008/3, n°130, pp.17-42. [En ligne] URL : https://www.cairn.info/revue-herodote-2008-3-page-17.htm
- PITRON Guillaume (2018), La guerre des métaux rares : la face cachée de la transition énergétique et numérique, Paris, Éditions Les liens qui libèrent, 296 pages.
- REBIERE Noémie, « Énergie et géopolitique régionale : quel avenir pour le hub turc ? », Orients Stratégiques (n°6), L'Harmattan, Paris, 01/2018, pp.1-15.
- ROTILLON Gilles (2010), Économie des ressources naturelles. Collection Repères, Paris, Édition La Découverte, Collection Repères,128 pages.

Resources

Teaching team: Raphaël DANINO-PERRAUD (PhD in economics, French Ministry of Defence), David JUILIEN, Wahel RASHID, Audrey SÉRANDOUR, Matthieu BRUN, Léa GOBIN, Angélique PALLE, Noémie REBIERE

Learning outcomes covered on the course

At the end of this course, students will be able to :
- adopt a critical view of resources, discuss the issues of access, distribution and control of these resources, and problematize the issues raised by their

exploitation and circulation;
- have factual knowledge on a variety of case studies, located on several continents (Europe, Asia, Latin America) and analyzed at various scales (global, regional, national, local);
- master the basics of the geopolitical analysis method and its key concepts (actors, power relations, representations, territories). He will be able to identify the relevant actors and detect the power relations crystallized around a resource or an object, at various scales;
- read a map and understand it from a geopolitical and critical perspective. They will also have acquired the basics of freehand cartography.

Description of the skills acquired at the end of the course

analyze: study a system as a whole, the situation as a whole. Identify, formulate and analyze a system within the framework of a transdisciplinary approach with its scientific, economic, human dimensions, etc.
C2.2: Import knowledge from other fields or disciplines
C5.3 : Analyze global and/or local issues at the international level and adapt projects or solutions to them

SCIENCE AND ENGINEERING CHALLENGE N°5 COURSES

ST5 – 51 – PILOTING AND FLIGHT CONTROL IN AERONAUTICS AND SPACE TRANSPORTATION

Dominante : GSI (Large Interacting Systems) and CVT (Construction, City and Transport)
Langue d'enseignement : French
Campus où le cours est proposé : Paris-Saclay

Engineering problem

This sequence addresses the problem of designing flight control laws and dynamic control of vehicle flight (aircraft, satellite and launcher). It aims to give students the basic concepts associated with the design of control systems of a flying object around its 6 degrees of freedom in order to ensure stability of operation and the required performance. The technologies in the fields of aeronautics and space being in constant evolution (propulsion, structure, materials, etc.), the laws of piloting must adapt to guarantee the best performances while taking into account the new constraints, in particular regulatory, environmental and economic.

The integration course allows students to apply the skills and knowledge acquired in the case of an aircraft, a nanosatellite and/or a launcher. These vehicles have become very popular in recent years due to the reduced cost associated with their construction and operation. However, it raises new problems, in particular for the control of attitude and performance due to the miniaturization of the components and thus the reduction of their capacities of action and their effectiveness.

The intervention of industrialists from the aeronautics and space sector in this sequence allows a better understanding of the issues associated with the design and operation of increasingly constrained systems.

Adviced prerequisites

Two main topics are covered in this sequence: modeling of undeformable objects and modeling of linear systems (transfer functions, state representation, differential equations) for control. These recommended prerequisites are part of the common course of Modeling (ST2) and the SPI course of Mechanics and Continuous Media. The rest of the necessary skills are based on the capitalization of CPGE knowledge and self-training.

Context and issue modules: The introduction of the sequence is organized around four half-days of training aiming at presenting the sequence, the integration teaching and introducing the stakes of the various sectors of space and aeronautics, according to the actions:

1. Presentation of the thematic sequence and introduction to the integration lessons

2. Conference on the civil and military aeronautics sector: from the design of airliners to operations and traffic management (speaker: Air France, Dassault Aviation)

3. Conference on applications and uses in space (speakers: CNES, Thalès Alinea Space)

4. Introductory conference on the law of space activities (speaker: Institut du Droit de l'Espace et des Télécommunications, IDEST). Introduction to the concepts of liability and insurance (speaker: ArianeGroup). Conference on the economy in space (speaker: CNES).

5. Conference on sustainable development in aeronautics and space (speaker: Parrot, ESA).

Specific course (60 HEE) : *Performance and flight trajectories*

Brief description : The objectives of this specific course are to:

- model the behavior of a vehicle in flight in the framework of rigid body mechanics,

- describe the dynamics of vehicles in the case of flights in and out of the atmosphere (trajectory, eigenmodes, instabilities)

- choose and deploy control and piloting strategies.

It is organized in two steps. First, based on the mechanics course offered in the first year, the mechanics of rigid bodies is introduced to give the necessary tools for the construction of models of aircraft, launchers, satellites, UAVs... For this, two courses will give the basic concepts of flight mechanics and space mechanics. In a second phase, the course will describe the dynamics and control strategies of an aircraft, a satellite and a launcher. These three phases of the course will involve several actors from the aeronautics and space sectors. The sessions will provide an understanding of the models used and the control strategies to be used. The students will take control tools on a specific system and will be able to set up a control strategy in a pre-project phase during the integration teaching.

Challenge Week :

Preamble: The three integration courses are built in the same way and cover the same learning objectives. The aim is to start from a performance specification for an aircraft, a nanosatellite or a launcher and to make architecture and piloting choices to ensure the expected performance. The common objectives are therefore:

- Understand the constraints of flying systems, and the different levels of modeling of dynamic behavior

- Choose the relevant technical solutions for the control of trajectory, stability and orientation (sensors/actuators...)

- Design a complete system by modeling, including actuators and sensors, actuator sizing, power generation and CPU capacity

- Implementation of an optimal control law, taking into account economic aspects

- Validation of the control law on a realistic model

Challenge week n°1 : *Control strategy for a nanosatellite*

- Associated partner: Thalès Alenia Space via the CentraleSupélec Space Center

- Location: Paris-Saclay campus

- Brief description: This integration course will be conducted in collaboration with Thalès Alenia Space. The objective is to design a nanosatellite (Cubesat). For a specific mission defined by a specification, participants will propose an orbit, choose the satellite components, design the operating modes and develop a control law.

Challenge week n°2: *Definition and design of a launcher mission*

- Associated partner: CNES Direction des Lanceurs

- Location: Paris-Saclay campus

- Brief description : The objective of this integration course is to bring the students, through a space launcher design project, to experience a multi-disciplinary dimensioning loop. To this end, the project is articulated in modules reflecting the unfolding of a design loop, with CNES DLA (Direction des Lanceurs) engineers accompanying the students during each of these modules.

Challenge Week n°3: *Aircraft design*

- Associated partner: Dassault Aviation

- Location: Paris-Saclay campus

- Brief description: The objective of this challenge week is to discover the different stages of the design process of a business aircraft, both from a theoretical and a practical point of view. The study will focus on the design of the aircraft and improvement of its performance, the development of a control law, and the risk analysis and certification associated with the developed solution.