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Western alliance for scientific actions with Australia

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# 2019 Summer School

# New Trends in Information Technologies

## Course Information

| Name: | New Trends in Information Technologies |
|---|---|
| Teaching Institutions: | Wasaa Consortium |
| Location: | Brest, France |
| Dates: | 14th January-1st February |
| Duration: | 3 weeks |
| Course contact hours: | 24 hours of academics classes, 12 hours of professional visits to industrial companies, including Thales and Naval Group, 12 hours of cultural activities, including initiation to French language. |
| Pre-requisites: | The program is accessible to students having completed one year in engineering sciences. |
| Course equivalencies: | 6 European Credits (ECTS) |
| Language of instruction: | English |

## Wasaa Consortium

The five universities participating in the 2019 summer school (UBO, ENIB, ENSTA Bretagne, IMT Atlantique and Naval Academy) are members of the Wasaa group.

Wasaa (Western Alliance for Scientific Actions with Australia) is a consortium of French higher education institutions in Western France interested in establishing partnerships with higher education institutions in South Australia. The cooperation is based on the inter-governmental agreement signed on 20 December 2016 in Adelaide between Australian Prime Minister Malcolm Turnbull and the French Defense Minister Jean-Yves Le Drian. Wasaa's objectives are to strengthen research partnerships between signatory institutions and encourage student exchanges between France and Australia.

The program has obtained the label "Creative France short program" awarded by the Embassy of France in Australia.

# Instructors Informations

The course is taught by:

- Prof. Cédric Buche (ENIB): Artificial Intelligence and Robotics
- Prof. Thierry Duval (IMT Atlantique): Virtual Reality, HCI
- Asso. Prof. Nicolas Farrugia (IMT Atlantique): Machine Learning and Neuroimaging.
- Asso. Prof. Mikael Guegan (ENIB): Optical Fiber Communications
- Prof. Ronan Querrec (ENIB): Virtual and Augmented Reality
- Asso. Prof. Benjamin Potelon (UBO): Space Communications
- Asso. Prof .Catherine Sablé (IMT Atlantique): French Langage and Intercultural Skills
- Asso. Prof. Mathieu Simonnet (IMT Atlantique): Physiological Issues in IT
- Asso. Prof. Johanne Vincent (IMT Atlantique): Cybersecurity

# Materials

Students will be provided with all learning materials (including relevant reading lists) on arrival at IMT Atlantique. During the program students will have access to computing facilities, though students are advised to bring their own laptop if they have one.

# Course Description and Learning Outcomes

The course will allow students to explore the latest trends in information technologies, including virtual reality, artificial intelligence, robotics, cybersecurity, optical and satellite communications.

It will also be a first introduction to laboratory research work as well as a discovery of the French academic environment.

## *Organization of the course*

**During the first week,** the students will be proposed French courses, company visits and cultural activities.

**During the second week,** the students will choose 4 courses of 6 hours (option A or B) each including lectures and practical work.

**During the third week,** the students will be integrated into the research laboratories of IMT Atlantique, ENSTA Bretagne UBO or ENIB where they will carry out research work in small groups (maximum 5 students) supervised by professors and PhD students.

# *Timetable*

**Week 1**

| Day | Date | Time | Content |
|---|---|---|---|
| Monday | 14 | AM | Welcome |
| Monday | 14 | PM | Cultural Visit |
| Tuesday | 15 | AM | Initiation to French Language and intercultural Skills |
| Tuesday | 15 | PM | Industry Visit |
| Wednesday | 16 | AM | Visit of the Naval Academy |
| Wednesday | 16 | PM | Visit of the Naval Academy |
| Thursday | 17 | AM | Initiation to French Language and intercultural Skills |
| Thursday | 17 | PM | Industry Visit |
| Friday | 18 | AM | Initiation to French Language and intercultural Skills |
| Friday | 18 | PM | Cultural Visit |

**Week 2**

| | | | Option A | Option B |
|---|---|---|---|---|
| Monday | 21 | AM | Artificial Intelligence and Robotics 1 | Introduction to fiber-optic communications and power over fiber systems 1 |
| Monday | 21 | PM | Artificial Intelligence and Robotics 2 | Introduction to fiber-optic communications and power over fiber systems 2 |
| Tuesday | 22 | AM | Initiation to Virtual Reality and Augmented Reality 1 | Principle of RF space communications systems 1 |
| Tuesday | 22 | PM | Initiation to Virtual Reality and Augmented Reality 2 | Principle of RF space communications systems 2 |
| Wednesday | 23 | AM | Coopération in Virtual Reality | Introduction to experimental design with physiological measurement 1 |
| Wednesday | 23 | PM | Free Time | Free Time |
| Thursday | 24 | AM | Cybersecurity Awareness 1 | Practical machine learning applied to brain signals 1 |
| Thursday | 24 | PM | UBO Fablab Visit | UBO Fablab Visit |
| Friday | 25 | AM | Coopération in Virtual Reality 2 | Introduction to experimental design with physiological measurement 2 |
| Friday | 25 | PM | Cybersecurity Awareness 2 | Practical machine learning applied to brain signals 2 |

Note: The organization of the courses may change slightly depending on the availability of
the teachers.

## *Industry Visits (week 1)*

The industrial visits will focus mainly on companies involved in the shipbuilding and defense sectors including Thales and Naval Group.

Half a day will allow students to discover the Fablab of the UBO and to build their own prototype.
Another day will be dedicated to the visit of the Naval Academy located on the breathtaking site of the bay of Brest.

## *Cultural activities (week 1)*

Cultural visits will give the students a chance to discover Brest and its beautiful surroundings including:

- The bulky Ruins of the Medieval Abbaye of St-Mathieu,
- Oceanopolis , the Ocean Discovery Park,
- Les Capucins, the historical mechanical workshops of the arsenal of Brest.

Introductory sessions to French language and intercultural practices will be offered during the first week.

During all three weeks the students will also be proposed evening activities such as wine tasting or crêpes making as well as many social activities with French and international students.

## *Academic Classes (week 2)*

| Title of the module | **Artificial Intelligence and Robotics** |
| --- | --- |
| Code | EE A 201 |
| Teacher | Prof. Cédric Buche |
| Institution | ENIB |
| Number of Hours | 6h |
| Description | In this course, students will experience the basics of modern Artificial Intelligence (AI) applied to robotic. For labs, they will manipulate NAO robot. NAO is humanoid, two arms, two legs, eyes, ears, he can walk and talk. Two types of demonstration will be available: NAO playing soccer and PEPPER (a human-shaped robot) welcoming people. |
| Requirements | - Basic knowledge in information systems<br>- Basic knowledge in computer networks, OS, and applications |

| Title of the module | **Initiation to Virtual Reality and Augmented Reality (VR/AR)** |
|---|---|
| Code | EE A 202 |
| Teacher | Prof. Ronan Querrec |
| Institution | ENIB |
| Number of Hours | 6 hours |
| Description | During this course we will present the basic concepts of virtual reality and augmented reality. We will also discuss the different types of interaction and immersion devices. We will also realize a small project under Unity3D to implement some concepts discussed during the course. Finally, we will propose to test different types of devices. |
| Requirements | - Basic knowledge in information systems<br>- Basic knowledge in computer networks, OS, and applications |

| Title of the module | **Cooperation in Virtual Reality** |
|---|---|
| Code | EE A 203 |
| Teacher | Prof. Thierry Duval |
| Institution | IMT Atlantique |
| Number of Hours | 6 hours |
| Description | During this course we will present the basic concepts of Collaborative Virtual Reality (a.k.a Collaborative Virtual Environments) which aims at enabling several users to cooperate within a virtual environment. First we will expose the requirements of such systems from the point of view of the end-users who want to collaborate in a shared virtual environment. Then we will discuss the most common metaphors used to make a user aware of the activity of the other users, and the different kinds of software and network architectures able to meet these requirements for such shared virtual environments. We will also realize a small project under Unity3D to implement some concepts discussed during the course, making it possible to share a virtual environment between several users distributed over a Local Area Network. |

| Title of the module | **Cybersecurity Awareness** |
|---|---|
| Code | EE A 204 |
| Teacher | Asso. Prof. Johanne Vincent |
| Institution | IMT Atlantique |
| Number of Hours | 6h |
| Description | In the past few years, cyberattacks have increased drastically against states, companies or the general public. In this brief introduction to cybersecurity you will learn the basic concepts of cybersecurity and will learn about the best practices in computer security.<br>Goals:<br>• Understand the motivations behind the need for security<br>• Comprehend methods and norms for security<br>• Learn the basic definitions and typology of threats<br>• Learn the best practices for both personal and professional IT<br>• Understand basic system and network vulnerabilities<br>• Introduction to cryptography<br>• Grasp the difficulties of implementing security mechanisms in organizations |
| Requirements | - Basic knowledge in information systems<br>- Basic knowledge in computer networks, OS, and applications |


| Title of the module | **Introduction to Fiber-Optic Communications and Power over Fiber Systems** |
|---|---|
| Code | EE B 201 |
| Teacher | Asso. Prof. Mikael Guegan |
| Institution | ENIB |
| Number of Hours | 6 hours |
| Description | The main goal of this course is to introduce students to the field of fiber-optic communications and to the recently developed power over fiber systems for sensors monitoring and feeding. An overview on a typical optical communication link will be presented involving the description of the main used devices as for example the optical fiber characteristics, the emitter and receiver (modem) properties. A specific focus will be made about the power over fiber systems used to transmit energy and to exchange data with a network of sensors, which is an interesting solution in the framework of hostile environments.<br>Mainly devoted to the dissemination of the key concepts, this course will lean on practical class and laboratories of demonstration using a dedicated simulation tool and specific material equipments and instrumentations (optical spectrum analyser, reflectometer,…). |
| Requirements | - Basic knowledge in physics |

| Title of the module | **Principle of Radio-Frequency space communications systems** |
|---|---|
| Code | EE B 202 |
| Teacher | Asso. Prof. Benjamin Potelon |
| Institution | UBO |
| Number of Hours | 6 hours |
| Description | The main goal of this course is to introduce students to the field of Radio-Frequency communications and particularly microwave systems dedicated to space applications.<br>An overview of the paradigm of microwave links will be detailed and key RF link budget issues will be introduced.<br>Focus will then be made on the architecture of the transmitter and receiver systems and specific features of the main components will be highlighted (antennas, filters, amplifiers, mixer). |


| Title of the module | **Introduction to experimental design with physiological measurement** |
|---|---|
| Code | EE B 203 |
| Teacher | Asso. Prof. Mathieu Simonnet, Charlotte Hoareau |
| Institution | IMT Atlantique |
| Number of Hours | 6 hours |
| Description | This interactive teaching aims to introduce to the different steps of an experimental plan.<br>How to formulate a hypothesis based on literature basis or pragmatic conviction?<br>What are the different issues when setting up an experimental plan? Feasible measured variables in ecological situation will be identified and examples of data set and results analysis to verify hypothesis will be tackled.<br>We will keep a special focus on sleep studies and physiological data collection. After presenting experimental concepts and examples we will manipulate real time physiological measurement tools (HR, EEG and/or breath rhythm …) and students will be asked to imagine original studies by their own. |

| | |
|---|---|
| Title of the module | **Practical Machine Learning Applied to Brain Signals** |
| Code | EE B 204 |
| Teacher | Asso. Prof. Nicolas Farrugia |
| Institution | IMT Atlantique |
| Number of Hours | 6h |
| Description | This course is a hands-on tutorial on machine learning applied to brain signals. We will begin by a short course on basics of scientific data analysis, including basic statistics on temporal and spatial signals, as well as basic modeling. We will directly apply these techniques to brain signals, such as functional Magnetic Resonance Imaging (fMRI) with human participants. Next, we will introduce the basics of machine learning with a practical approach using the python packages sk-learn and nilearn. Students will work on machine learning problems on open fMRI datasets, such as (A) predicting object categories from brain activity of subjects looking at pictures, (B) modeling whole brain activity of subjects watching videos, (C) predicting age from brain structure, or (D) classifying brain disorders using spontaneous brain activity. |

## *Projects (week 3)*

The assignment of subjects will be based on the students' background and their professional project. It will be confirmed during the first week of the summer school.

**Examples of topics that may be addressed:**

- Cooperative Virtual Reality
- Fatigue and under-vigilance analysis of operators
- Underwater autonomous vehicles
- Optical and microwave devices
- Artificial intelligence, robotic vision and learning

## *Learning outcomes*

The objective of the course is:

1) to introduce students to the diversity and attractiveness of new developments in information technologies and to raise their awareness of their impacts on industry and society.

2) to introduce them to French companies based in Australia and to acculturate them to the French higher education system.

3) to raise their awareness of research work in this field by immersing them in the research laboratories of partner universities.

# Validation and Credits

Students will be required to comply with IMT Atlantique's policies regarding plagiarism and academic integrity.
Students will receive an academic record for the course as well as a certificate.
Students who meet the requirements of the three weeks will be awarded 6 credits (ECTS).

**Week 1:** Regular participation in the proposed activities 30%
**Week 2:** Small MCQ at the end of each course module 30%
**Week 3:** Twenty minutes of oral presentation of their project results 40%

## *Grade description*

| | |
|---|---|
| **Excellent achievement**<br>**Participation:**<br>● Exceeded expectations<br>● Participated actively in all classes conferences and site visits; asked relevant questions<br>● Contributed to class with relevant information.<br>● Demonstrated cross cultural understanding<br><br>**MCQ : 75-100%**<br><br>**Project Defense:**<br>● Exceeded expectations<br>● Demonstrated above average knowledge of topic.<br>● Innovative: used variety of materials to convey information<br>● Conveyed information in clear, informative and entertaining manner.<br>● Presentation was engaging for classmates. | 75-100% |
| **Good achievement**<br>**Participation:**<br>● Participated actively in class and visits<br>● Was engaged<br>● Some participation was not clearly focused<br><br>**MCQ : 50-75%**<br><br>**Project Defense:**<br>● Presentation was interesting and engaging, but lacked some clarity and explanation<br>● Failed to engage the full class<br>● Was unable to answer some of the questions | 50-75% |
| **Fail**<br>**Participation:**<br>● Scarcely participated<br>● Showed no engagement in class<br>● Student was engaged in other activities during classes and visits<br>● Demonstrated no cross cultural understanding<br><br>**MCQ < 50%**<br><br>**Project Defense:**<br>● Presentation lacked clarity and was not engaging of fellow students in the classroom | 59-0% |