HSI Course Project Details
January 3-14, 2022

Projects

Projects	Advisors/Referents
All projects	Guy Andre Boy (g.boy@estia.fr)
1. INNOMED: General Practitioner-centered Health sys	Maika Touzet (mtouzet001@ensc.fr) Jean-Benoit Pecastaing (dr.jbpecastaing@gmail.com)
2. FCAS (Future Combat Air Sys) shared situation awareness sys	Daniel Hauret (daniel.hauret@fr.thalesgroup.com) Chloé Morel (c.morel@estia.fr)
3. Digital aviation air traffic system	Thomas Brethomé (thomas.brethome@csgroup.eu) Dimitri Masson (d.masson@estia.fr)
4. Small nuclear reactors system	Bertrand Lantes (bertrand.lantes@wanadoo.fr) Ludovic Loine (ludovic.loine@gmail.com)
5. Digital twin for helicopter engine diagnostic and repair system	Quentin Lorente (q.lorente@net.estia.fr) Christophe Merlo (c.merlo@estia.fr) François Thermy (francois.thermy@safrangroup.com)
6. Offshore oil-&-gas platform telerobotic system	Élise Durnerin (e.durnerin@estia.fr) Dimitri Masson (d.masson@estia.fr) Eric Bartoli (eric.bartoli@total.com)
7. No-code Authoring of Non-linear Training Experiences for Rescue Operations	Philippe Palanque (palanque@irit.fr) Olivier Balet (olivier.balet@csgroup.eu)

Expectations

Students are expected to provide a full literature review (both scientific and technological), an appropriate problem statement of the project and requirements that have been assigned to. Depending on the complexity of the project, they should provide a first mock-up of the system to be designed (a PowerPoint slide presentation). Every day (4, 5, 6, 8 & 11 January) a small work-in-progress report on the project should be posted. Product should be as complete, clean and original as possible.

Procedure

1	• You will fill in the table of scores (Excel spreadsheet) (most preferred [7]; less preferred [1])	December 8, 2021
2	• We (lecturers) will form groups (4 or 5 students) … there will be 7 groups of 4 and one group of 5	December 10, 2021
3	• We will inform you about the groups	December 13, 2021
4	• You provide your agreements	December 14, 2021
5	• We will have a general oral presentation of the projects and groups at the beginning of the HSI course (for 2 hours and morning) • You will have to think about your project topic and bring directions straightaway	January 3, 2022
6	• Each day, you will be able to interact with us on your project for 10 to 15 minutes, in the morning (12:00-12:30) and afternoon (17:30-18:00), via email and/or TEAMS (see your advisors/referents)	Jan 3-14, 2022
7	• Final presentation of each project (15 minutes + 5 minutes Q&A) – (14:00—18:00)	January 14, 2022
8	• Project paper of each project, 6 pages, ACM format (provided)	January 21, 2022

Short project descriptions

1. INNOMED: General Practitioner-centered Health system (VP + GAB)

Imagine a national health system (e.g., in France) where your general practitioner would come to your house and have a primary role in your health, connecting you to the best hospital specialists, filtering and framing your current specific disease (when appropriate of course) and most importantly knowing you as a mentor and constant health support. What would the national health system look like? What kind of technology would be developed to support such a system? What king of human-centered artificial intelligence (AI) should be developed to support the general practitioner? How would you design connectivity between you, the general practitioner, the hospital, the national health system, etc.? Could you take the COVID pandemic as an example?

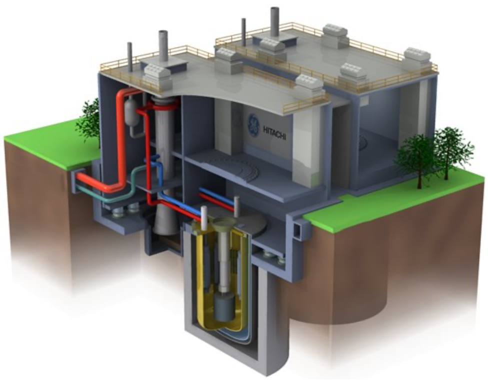
2. FCAS (Future Combat Air System) shared situation awareness system (CM + JPG)

The Future Combat Air System (FCAS) is a European combat system of systems (SoS) under development by Airbus, Thales Group, Indra Sistemas and Dassault Aviation. The FCAS will consist of a Next-Generation Weapon System as well as other air assets in the future operational battlespace. There will be a mix of piloted aircraft and drones that will have to be coordinated. This will be a multi-agent system, in the AI sense. How would you state the overall problem to be solved? How would you model the situation awareness (SA) problem for each pilot, and more generally each FCAS stakeholder? What do we mean by shared SA? What would you provide each FCAS stakeholder with? What kind of organization? What kind of complexity?

3. Digital aviation air traffic system (GAB + PB + DM)

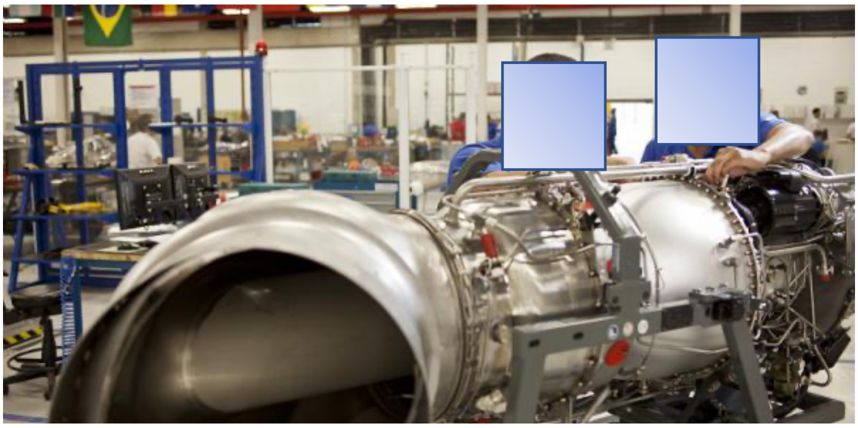
Digital aviation has often been cited as being the next significant business transformation in the sector and one which can support the aerospace industry towards delivering greater customer satisfaction, while addressing efficiency, cost and capacity issues. A Digital Air Traffic System (DATS) will provide new kinds of support for air traffic control (ATC) and, more generally, air traffic management (ATM). The digital air traffic control tower (DATCT) should enable smarter approaches and new airport functions that will need to be integrated. DATS should enhance controller's situational awareness, enabling quick and informed decisions. DATCT should provide a 360-degree view of the airport and the ability to zoom-in on aircraft, improving visibility. How would you model the resulting system of systems (SoS)? How would you allocate functions of cyber-physical systems and human operators? You should take a scenario-based design approach.

4. Small nuclear reactors system (GAB + BL + LL)



At a time when climate change issues are extremely serious, nuclear energy comes back to the front line. How can we imagine sustainable electric vehicles without sustainable and affordable energy source. Advanced Small Modular Reactors (SMRs) could be good solutions for developing safe, clean, and affordable nuclear power options. Advanced SMRs can vary in size from tens of megawatts up to hundreds of megawatts, can be used for power generation, process heat, desalination, or other industrial uses. SMR designs may employ light water as a coolant or other non-light water coolants such as a gas, liquid metal, or molten salt. SMRs advantages are relatively small physical footprints, reduced capital investment, ability to be sited in locations not possible for larger nuclear plants, and provisions for incremental power additions. SMRs also offer distinct safeguards, security and nonproliferation advantages. How would you develop and organize SMRs? What would be the organizational and safety issues?

5. Digital twin for helicopter engine diagnostic and repair system (QL + CMerlo + FT)

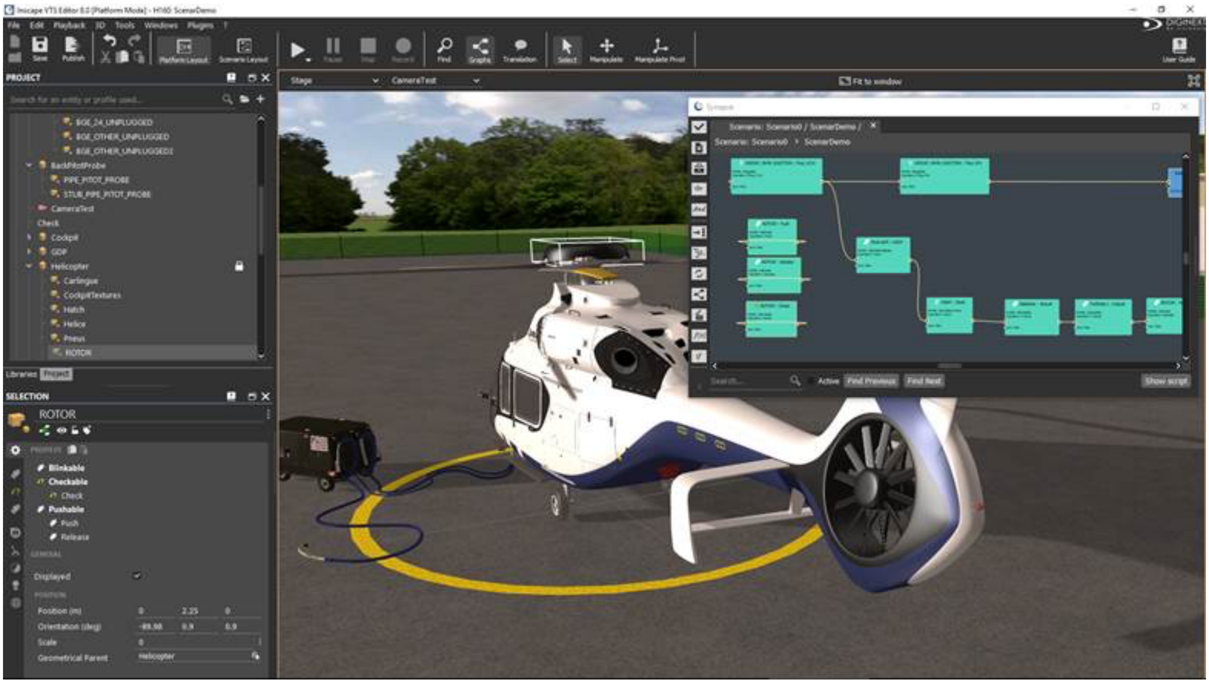


We are looking for effective diagnostic tools for maintenance to optimize maintenance and anticipate downtime based on experience. Indeed, reactive problem solving is relatively expensive given the variety of configurations in service. In addition, the strength of helicopter engine manufacturers lies in the competence of their human operators and the growing volume of data collected from flight and maintenance records. The aim of this project is to provide support to MRO (Maintenance, Repair and Overhaul) teams, to help them in their daily activities, using digital twins (DTs) from the fleet of engines in service. How would design such DTs for diagnosing failure and helping maintenance personnel to explore "what-if" possibilities? Who are the stakeholders? What kind of AI technology would you choose and implement?

6. Offshore oil-&-gas platform telerobotic system (ED + DM + EB)

Off-shore drilling platforms are currently operated by people. It is a very dangerous business. Therefore, oil-&-gas companies are developing robotic systems that will replace these human operators. In addition, the design and development of such robotic systems should consider their remote control and management. The overall system is a very complex system of systems. What are the various machine and human systems that should be developed? What kinds of socio-cognitive issues should be considered? What kinds of robots should be considered? What should the level of automation and autonomy? What should be anticipated in case of failures and unexpected situations?

7. No-code Authoring of Non-linear Training Experiences for Rescue Operations (OB + PP)



Operational preparedness is essential for civil security organisations (e.g. firefighters, USaR and medical teams, LEAs) that shall train for the unexpectable in societies threatened by increasingly severe, and complex, natural and man-made disasters. For this purpose, new concepts exploiting modern technologies, such as eXtended Reality and simulation, have been introduced and proved extremely effective for the training of multiple participants immersed in a wide range of complex interactive scenarios. However, one of the main barriers preventing a wider adoption of this approach is the difficulty for security experts to create scenarios without the assistance of software developers, and the cost to develop such scenarios that shall orchestrate a collaborative user experience immersing trainees in a Digital Twin of the real-world populated by a multitude of virtual elements and systems (e.g. drones, rescue vehicles, shelters, sensors, effectors, incidents, population).

No-code methodologies, such as visual programming, are a very promising way for intuitively creating non-linear scenarios without requiring technical skills as demonstrated by systems such as Unreal Engine's blueprint or Inscape (https://inscape3d.com/en/virtual-training), one of the first and most advanced authoring tool that adopted this approach for creating maintenance training experiences. Still, the authoring of scenarios defining incidents and rescue operations is of a higher complexity requiring inventing new visual metaphors and graph-based representation to orchestrate all the entities and systems involved in a rescue operation without requiring to use the visual authoring tools for low level programming.

Time schedule

There are four types of events in the Daily Schedule below:

L_n: Lecture number n (**presence to all lectures is mandatory**)
P_m: Project slot number m (during P_1, we will review all projects; P_2 to P_{11} are allocated slots for interactions with your project referents via TEAMS or telephone)
C_p: Industrial Case number p (real-world cases will be given by professional experts)
E_r: Exam number r (E_1 consists in answering 20 straightforward questions in one hour; documents are allowed, but if you consult them, you may not have enough time to finish – advise is be present at all classes; E_2 consists in presenting your project facing an evaluation committee)

Daily Schedule Human Systems Integration Course

Start January 3, 2022 Start Time: 8:30 AM

	Mon 3 Jan	Tue 4 Jan	Wed 5 Jan	Thu 6 Jan	Fri 7 Jan	Mon 10 Jan	Tue 11 Jan	Wed 12 Jan	Thu 13 Jan	Fri 14 Jan
8:30 AM										
9:00 AM	L1. Introduction	L4. Organization	L6. Complexity	L9. Platform for	L13. AIM &	L10. HOF Mgt	L14. Design for			
9:30 AM	to HSI	Design & Managt	Analysis	MBSE	Automation	Risk Mgt	Flexibility			
10:00 AM	GAB	GAB	GAB	GAB +Stéph. Vales	GAB	GAB + LL + BL	GAB			
10:30 AM	Break	Break	Break	Break	Break	Break	Break	Break		Break
11:00 AM	P1. Introduction	L5. Systemic	L7. Ethnographical	C4. REX/Digital Twins	L15. HF	C5. Nuclear Power				
11:30 AM	to	Cognitive Engineering	Design (GEM)	Stélian Camara	Evaluation	OPS & Waste Mgt				
12:00 PM	the	GAB	GAB	C7. Robot Fleet Mgt	Chloé Morel	Bertrand Lantes		P11. Projects:		
12:30 PM	Projects	P3. Projects	P5. Projects	DM	P7. Projects	P9. Projects		Evals + Final		
1:00 PM										
1:30 PM										
2:00 PM										
2:30 PM	L2. Functional	C1. Future Combat	L8. Scenario-Based		L11. HSI &	C5 (cont.).	L12. Advanced Interaction Media			
3:00 PM	Cognitive Engineering	Air System	Design - HITLS		Design Thinking	Nuclear Waste	GAB			
3:30 PM	GAB	Daniel Hauret	Dimitri Masson		GAB	Bertrand Lantes				E2. Projects:
4:00 PM	Break	Break	Break		Break	Break	Break			Final
4:30 PM	L3. Cockpit	C2. CS Group	C3. An HSI Example		E1. Mid-term Exam	C6. Nuclear Submarines	P10. Projects:			Presentations
5:00 PM	Design	proect	MOHICAN		Q&A (1 hour)	OPS & Risks	Agile Development			
5:30 PM	GAB	Olivier Balet	Chloé Morel			Ludovic Loine				
6:00 PM	P2. Projects	P4. Projects	P6. Projects		P8. Projects					

Students (28) in the 7 groups

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