Université de technologie de Compiègne – Thesis proposal

Part 1: Scientific sheet	
Thesis proposal title	Adaptive human-machine interface (HMI) for intelligent vehicle take over in virtual environment (Human-in-the-Loop) in critical situations
PhD grant	Doctoral work contract based on a Ministry of Research Grant
Research laboratory	unité de recherche : UMR Heudiasyc research team: SYRI web site: https://www.hds.utc.fr/recherche/equipes-de-recherche/syri-systemes-robotiques-en-interaction.html
Thesis supervisor(s)	Indira Thouvenin ECC HDR, Reine Talj CR CNRS HDR
Scientific domain(s)	Computer science and information technologies Science and technology
Research work	Despite advances in vehicle automation technology, decision-making aspects remain far from being able to replace human intelligence in all circumstances, especially in unknown or unexplored areas. We are therefore still far from level 5 of autonomy, which corresponds to complete autonomy of the vehicle in all driving situations, in which the driver is never called upon. Thus, the human driver must always remain present in the loop. The literature shows that when the situation is relatively anticipated by the human, regaining control is not a lock. On the other hand, in the event of a critical situation, this becomes a very complex problem which depends heavily on the effectiveness of the human system interface. Everything will depend on the attitude of the driver in this case. The cooperation between the human driver and the autonomous system is then essential for the actuation of the vehicle which requires that the human-system interaction is adapted in real time to the situation, the state of the vehicle and the state. of the driver. We are interested in this project in the sudden arrival of an obstacle putting in default the autonomous system. The first reaction of the automated vehicle at low speed results in braking when an obstacle arrives, while at high speed, it results in obstacle avoidance based on a lateral movement of the vehicle. However, in the event of a limitation of the autonomous system, it is important to give control back to the driver, and for this, the latter must be attentive, available and responsive. Work on regaining control shows that sensory feedback is a powerful means of arousing the driver's attention. For example, it is possible to use a haptic system (touch bracelet on the driver's wrist), or visual feedback on the windshield. The pitfall of these sensory feedbacks is that they do not take into account the attention or the availability of the driver, and that they are always the same whatever the situation. We therefore propose to design adaptive, dynamic sensory feedback to avoid this pitfall. Our work will be based on the attention model [1] and the human system cooperation model [2] already existing in the laboratory, and which will be extended to the target situation. The control of the scenarios in the driving simulator (CAVE) will allow us to create and validate our model. Our HMI will be able to adapt to the behavior of the driver and will take into account the cooperative control of the vehicle: in this way the driver will be able to understand the decisions of the cooperative mode.

	[1] Baptiste Wojtkowski, Indira Thouvenin, Veronica Teichrieb: AMI: Attention based Adaptative Feedback with Augmented Reality to Improve Takeover Performances in Highly Automated Vehicles. VISIGRAPP (2: HUCAPP) 2022: 99-107. [2] A. Hamdan, R. Talj et V. Cherfaoui, "A Fuzzy Logic Shared Steering Control Approach for Semi-Autonomous Vehicle", 20th International Conference on Advanced Robotics (ICAR), Dec. 2021, Ljubljana, Slovenia.
Key words	Semi-autonomous vehicle, informed interaction, decision, adaptive sensory feedback, recovery, cooperative control
Requirements	• Engineering or master's degree in computer science • Knowledge required in automation / robotics, and/or in virtual reality, HMI and computer science • Interest in experimental work, and in protocols implementation including human in the loop • A plus: knowledge on NASA TLX and Presence questionnaires, and knowledge in the field of statistical data analysis
Starting time	01/10/2023
Location	Heudiasyc laboratory, Compiègne, FRANCE

Part 2: Job description	
Duration	36 months
Additional missions available	Teaching, expertises
Research laboratory	Virtual, augmented, mixed reality, Robotics, Automatic, Artificial intelligence
Material resources	CAVE immersive room including the driving simulator
Human resources	(33 permanent EC, 6 CNRS researchers, 14 BIATSS/ITA, 46 doctoral students, 8 temporary researchers and visiting professors, 12 post-doc engineers)
Financial resources	
Working conditions	expected autonomy, missions (e.g. project follow-up, organization of meetings, etc.), weekly meetings with the thesis supervisors
Research project	ANR Project
National collaborations	The Institute of Movement Sciences, DR CNRS Daniel Mestre, is a privileged partner.
International collaborations	No
International cosupervision (cotutelle)	No
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Please contact first the thesis supervisor before applying online on https://webapplis.utc.fr/admissions/doctorants/accueil.jsf