

RESEARCH LINE 4B	
COMPANY	Repsol
PhD THESIS SUPERVISOR (UPM)	Prof. Dr. David Camacho Fernández <i>Computer Systems Engineering School</i> <i>Computer Systems Engineering Department</i>
PhD THESIS CO-SUPERVISOR (COMPANY)	Dr. Javier Juárez Montojo <i>Senior Scientific</i> <i>Repsol Technology Lab</i>
DESCRIPTION OF THE PhD THESIS PROJECT	<p>Over the last years, eco-routing has become a key concept in the field of vehicle routing due to the importance on reducing the fuel consumption and, therefore, the emissions of CO₂ and other pollutant gases, which is currently one of the top priorities in Europe to fight against the climate change. Because of this, the procurement of eco-routes becomes a key concept in the context of the Sustainable Development Goals (SGDs), specifically, of SDG 13 (Climate Action).</p> <p>One of the main drawbacks of eco-routes is that sometimes the selected route could imply the increase of travelled distance and time, making many drivers reluctant to follow these eco-routes. However, and using new Artificial Intelligence techniques, it is possible to obtain more efficient eco-routes that could be of interest for the end-users. Following this goal, eco-routes can take advantage of a Green Light Optimal Speed Advisory (GLOSA) system in order to recommend more efficient routes. In these GLOSA systems, the optimal speed to avoid braking when approaching a light is computed. Based on historical and online data of traffic and lights status, eco-routing algorithms could recommend better routes where traffic conditions would avoid unnecessary braking. Another key concept that should also be considered in the generation of eco-routes solutions for long distance travels is the optimization of the number of recharging stops, which can be considered as a new objective of the problem. The solutions to this problem will present a series of eco-routes ordered by fuel consumption, and the end-user can decide to follow the most adequate one.</p> <p>The main objective of the PhD thesis is the development of new and innovative eco-routing algorithms, which will generate or recommend the most optimal eco-route to reach a location. This will require the modelling of the eco-routing problem through the consideration of fuel/energy constraints, speed profiles, uncertain variables like traffic and climate conditions, the GLOSA system, and other features that could be selected by the end-user. One of the research questions underlying this thesis is to find new techniques and algorithms that allow finding optimal solutions from an energy consumption perspective while optimizing end-user satisfaction. To fulfil these goals, in this PhD thesis, it is proposed to combine Deep Learning and Multi-objective Optimization methods. Different metaheuristics will be proposed and developed by the PhD candidate in order to find nearly-optimal solutions within a small amount of time (near to real-time). In addition, to deal with some uncertain variables including GLOSA, traffic, wind and climate conditions, or queues in recharging stops, Deep Learning methods will be used for the prediction of these variables given an amount of historical data (which can become huge, and therefore a big data approach must be considered). This will allow the generation of more robust eco-routes. Finally, the PhD candidate will design and implement new algorithms, tools and software that are expected to be suitable for integration with other systems (e.g. GLOSA, intelligent traffic systems, etc.), to be tested in real scenarios, or develop new software applications and innovative services for the industry (energy, automotive, smart applications), taking a step further in the future of eco-driving and eco-routing technology.</p>
TRAINING ACTIVITIES	<p>The PhD candidate will work in a multi-disciplinary team of computer scientists and other engineers at UPM and Repsol. The candidate will perform a series of training activities during the completion of the PhD thesis include:</p> <ol style="list-style-type: none"> 1. State of the art revision on both research methods and techniques to be applied, and tool systems currently available in this domain.

	<ol style="list-style-type: none"> 2. Participation in training events organized within the company and the research group he/she works on during the PhD. 3. Participation in scientific seminars, research conferences and (summer/winter) schools and workshops outside UPM. 4. Software implementation and validation (tools and frameworks) in real scenarios. 5. Writing and publication of journal and conference papers, both in the field of Deep learning and Metaheuristics. 6. Research internships. 7. Writing of the PhD thesis.
SECONDMENT(S)	<p>Tentative:</p> <ol style="list-style-type: none"> 1. Natural Computing Research Group at the Leiden Institute of Advanced Computer Science (LIACS), Leiden University, The Netherlands. Supervisor: Thomas Bäck (https://scholar.google.com/citations?user=x7LEID0AAAAJ&hl=de) 2. Chair of Computational Intelligence, Otto von Guericke University Magdeburg, Germany. Supervisor: Prof. Sanaz Mostaghim (https://scholar.google.de/citations?user=bvgkhBAAAAAJ&hl=de)
REQUIREMENTS FOR CANDIDATES	<p>Degree: Master's degree on the field of Computer Science/Engineering, Artificial Intelligence/Machine learning, Data Science, Electrical Engineering, or optionally Mathematics (earned at the date of recruitment).</p> <p>Skills:</p> <ul style="list-style-type: none"> - Knowledge/experience on car mechanics and/or energy consumption - Software development (AI-based applications) - Machine learning algorithms development (e.g. Deep Learning) - Optimization algorithms development (deterministic/stochastic) - Scientific outreach and dissemination - Strong programming skills in languages such as R, Python, Java or C++ <p>Background:</p> <ul style="list-style-type: none"> - Energy/industry optimization - Machine learning (Deep Learning) - Metaheuristics <p>Interests:</p> <ul style="list-style-type: none"> - Application of AI/ML techniques to Industrial problems - AI/ML research & applications - Industry research & applications <p>We are looking forward for a talented and highly motivated candidate. He/she should have an independent and well-structured working style but has to be able to work in teams as well.</p> <p>Applicants will be required to meet the Marie Skłodowska-Curie Early-Stage Researcher eligibility criteria. In particular, at the time of appointment they should be within the first four years of their research career, have not been awarded a doctoral degree, and should not have resided in the host country (Spain) for more than 12 months in the last three years immediately before the appointment. Researchers are normally required to undertake transnational mobility (i.e. move from one country to another) when taking up the appointment.</p>