Job offer –Post-doctorate in Real-Time Traffic Management Using UAVs
(*For Non-French scientists only*)

Research Project Short Title as Submitted to CEFIPRA: "Real-Time Traffic Management Leveraging Machine Learning- Driven Unmanned Aerial Vehicle (UAV) Solutions**"** (RTUAV)
Principal Investigator contact (Name, Institution and email id): Pr. Angelo FURNO, ENTPE, University of Lyon, University Gustave Eiffel angelo.furno@univ-eiffel.fr
Reference Number of the Job Offer: IFI_CEF_24_14

Project description

- **Keywords**: Unmanned Arial Vehicle; traffic management; machine learning, traffic management software; heterogeneous traffic.

- **Context**: Traffic management is crucial in urban areas to ensure efficient vehicular movement, reduce congestion, and enhance road safety. The complexities of managing traffic intensify during peak hours, particularly in India, where dense populations, narrow roads, and diverse vehicle types contribute to frequent bottlenecks. For instance, major city intersections experience significant delays, especially when accidents or incidents occur. Currently, India's traffic management systems rely on signal-based controls and manual interventions, which often lack the adaptability required to handle real-time dynamics effectively. In contrast, developed countries have implemented advanced technologies such as adaptive signal controls and intelligent transportation systems, yielding better outcomes. Recognizing this gap, **integrating real-time drone-based traffic management combined with deep learning algorithms presents a promising solution**. **The proposed research aims to leverage such technology to improve traffic flow, reduce delays, and enhance incident response in India, while drawing comparisons from international case studies like the "Station Air" project in France.**

- **Abstract of the Research Project**: Real-time traffic management is a global necessity given the dynamic nature of traffic flows and their associated challenges. Unmanned Aerial Vehicles (UAVs) offer a unique opportunity to conduct real-time traffic management, particularly in heterogeneous and lane-free traffic conditions prevalent in emerging countries. However, there is a significant gap in the development of a comprehensive methodology for efficient traffic management using UAVs. To bridge this gap, a collaborative effort involving experts from Université Gustave Eiffel, the National Institute of Technology Calicut, and industry partners is proposed. This initiative aims to create a prototype and methodology for a real-time traffic management system based on UAVs, leveraging advanced Machine Learning (ML) algorithms for improved urban mobility and traffic control.

- **Scientific Objectives of the Project:**
  - Development of a methodology suitable in heterogeneous traffic conditions for accurate trajectory mapping using UAVs.
  - Develop a methodology to estimate traffic indicators through analysis of processed images and trajectories derived from UAVs.
  - Support the implementation of Machine Learning driven traffic management measures with inputs from UAVs.

- **Methodology and Timeline of the Project:**

  - **Objective 1**(**15 months**) includes selection of UAVs and calibrate sensors for data collection, selection of study networks (India and France), plan flight path, and schedule data collection, Execution of UAV flights, collect video data, and pre-process for noise removal, Implement and evaluate the detection and mapping methodology from the 'STATION AIR' project in the Indian context, developing a methodology for improved vehicular detection and trajectory mapping using alternative deep learning algorithms, Integrate detection and mapping algorithms into the system

- **Objective 2 (4 months)** includes developing integrated database of vehicle trajectory and image data, defining traffic indicator (say, occupancy, average speed, and flow) and extract relevant features from the integrated database for indicator estimation, identifying suitable machine learning models and train those models for traffic indicator estimation, Testing the models for the real-time traffic indicator estimation and validate using real ground data.

- **Objective 3 (11 months)** includes Selecting simulation software and calibrate simulation model with respect to various study networks, developing alternative traffic scenarios, generating set of traffic management measures and develop measure of effectiveness criteria, simulating alternative traffic scenarios and estimate the effectiveness of the alternative traffic management measures, identifying suitable Machine Learning models and train the model using simulation outputs, integrating real-time traffic indicator to the machine learning model, testing and validating the prototype, developing deployment planning for pilot study, conducting pilot study, evaluate system performance, and establish a feedback loop for algorithm improvement.

- **Objective 4 (6 months)** includes integrating network map into cloud source, integrating the systems of traffic indicator estimation, traffic management measures, and network map and developing software interface

The main objectives and timeline of the postdoctoral position will be the following:

- *Vehicle Tracking*: Develop and refine existing algorithms for detection association and tracking of vehicles over time (M1-M8).
- *Traffic Indicator Derivation*: Extract accurate traffic indicators from UAV data for real-time traffic management (M8-16).
- *Field Testing*: Conduct field tests to validate and optimize the developed solutions (M16-M24).

Candidate profile

- Candidates can be all nationalities except French. In case of double nationality (French and another one), the candidate is not eligible. In the context of CEFIPRA, Indian candidates are preferred
- Applicants for post-doctorate must have a PhD degree (or be in the process of obtaining one) ;
- No competences in French language is required
- Candidate competences: Unmanned Arial Vehicle; traffic management; machine learning, traffic management software; heterogeneous traffic.
- Expected starting date: **01-02-2025**

How to candidate ?

Documents to be provided :

i. A cover letter (reasons for the candidature, professional project …) max 2 pages
ii. A copy of the master's degree or a proof of the program followed (and expected date of end) OR A copy of the PhD degree or a proof of the PhD program followed (and expected date of defense) max 1 page
iii. A copy of results for previous scholarship (max 3 pages)
iv. International curriculum vitae (max 2 pages)
v. Two letters of recommendation: one from any Indian institution and one from the French institution planned to host the candidate –mandatory- (max 2 pages)
vi. All should be submitted within 1 pdf file of no more than 10 pages.

Applications should be submitted to the following email address: msi@ifindia.in mentioning the reference number of the Job offer clearly.

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Candidates are requested to contact the French scientific principal investigator of the project before submission. A recommendation letter from the scientific principal investigator is mandatory.

Benefits:

- Monthly allowance of 2400 euros for Post-Doc
- Travel allowance
- University fee
- Carte de séjour fee
- Campus France management fee
- Registration to the French social security scheme

Selection process:

Selection is made by a dedicated selection committee of at least 4 persons. Decisions will be transmitted by the Embassy of France to CEFIPRA. **No consideration will be given for candidates with no recommendation letter from the French institution.**

Criteria for applicants' selection:

Academic excellence

- Excellence of the Academic background, Academic records, Honors, Letters of support, Participation to international research projects, exchange programmes and conferences.

Motivation and qualities

- Academic maturity: appropriation of the thesis project (stakes and contexts) • Quality of the presentation (oral expression, skills for synthesis, English level) • Maturity of the professional project: capacity to project her/himself within five years in terms of career development.

About CEFIPRA:
Indo-French Center for the Promotion of Advanced Research (CEFIPRA/IFCPAR) is an Indian body which promotes scientific cooperation between France and India in advanced fields of Science and Technology. It is supported by the Department of Science and Technology, Government of India and the Ministry of Europe and Foreign Affairs of the French government