Job offer – Post-doctorate in
Real-Time Traffic Indicators and Resilience Analytics from UAV Video

(*For non-French scientists only*)

Research Project Short Title as Submitted to CEFIPRA: "Real-Time Traffic Management Using Unmanned Aerial Vehicles (UAVs)"
Principal Investigator contact (Name and email id): Angelo Furno, ENTPE, University of Lyon, University Gustave Eiffel "angelo.furno@univ-eiffel.fr" and Nour-Eddin El Faouzi, University Gustave Eiffel
Reference Number of the Job Offer: IFI_CEF_26_05

Project description

- **Keywords :** UAVs, Real-Time Traffic Indicators, On-board Video Analytics, Vehicle Trajectories, Resilience Monitoring, Edge Computing

- **Context** : This postdoctoral project at the Traffic Engineering Lab https://licit-lyon.eu/ (to become Emob-Lab on Jan. 1st 2026) at the University Gustave Eiffel, Lyon, builds upon a first phase of the RTUAV CEFIPRA project that established a complete UAV-based pipeline for vehicle detection and trajectory reconstruction using YOLO and DeepSORT. The next step is to transition from offline processing to real-time, on-board computation of traffic indicators. The objective is to consolidate the existing detection–tracking chain, strengthen its robustness in heterogeneous conditions, and enable its deployment on resource-constrained UAV hardware. The work will contribute to the development of resilience-oriented monitoring tools capable of detecting anomalies, drifts, and rapid changes in traffic states under dynamic, uncertain, or extreme conditions. The postdoctoral position will be carried out in collaboration with NIT Calicut, integrating complementary expertise in computer vision, machine leaerning and traffic analytics.

- **Abstract of the Research Project** : This postdoctoral project focuses on transforming the UAV-based vehicle detection and trajectory reconstruction pipeline into a real-time operational solution able to compute traffic indicators on the fly. Building on the first postdoctoral work (which developed a full detection-tracking chain and performed a benchmark against existing solutions such as TwiX, https://github.com/Guepardow/TWiX) the new objective is to consolidate, optimize, and deploy the pipeline for real-time inference on lightweight embedded hardware.The project will address key challenges in real-time analytics, including optimization of inference time, efficient trajectory reconstruction, and the extraction of robust traffic indicators (flows, speeds, headways, lane-level dynamics, stop-and-go patterns). A systematic performance study will be conducted to quantify the reliability of online indicators compared to offline ground truth, focusing on inference latency, false positives/negatives, tracking stability, and reconstruction quality.

  Beyond performance evaluation, the project aims to validate the system in resilience-oriented contexts. The candidate will design and test anomaly- and drift-detection mechanisms to identify sudden changes in traffic conditions, disruptions (incidents, blockages), and context shifts (special events, heterogeneous traffic patterns). Additional evaluation will be conducted under more extreme conditions such as low-visibility weather, atypical demand surges, or congestion breakdowns.

  Field tests, including real UAV flights, will be carried out to validate real-time operation, hardware integration, and operational scalability. The candidate will work jointly with NIT Calicut to refine computational strategies and integrate the methodological advancements into a robust prototype suitable for rapid deployment in operational traffic monitoring.

- **Scientific Objectives of the Project** :

  - **Consolidate and optimize the detection–tracking pipeline** developed during the previous postdoc, integrating lessons learned from the comparative performance study and ensuring stability across diverse UAV configurations.
  - **Develop real-time extraction of traffic indicators** (flow, density proxies, speed distributions, trajectory-based metrics, stability indicators) from vehicle trajectories reconstructed on the fly.
  - **Implement and evaluate resilience-oriented monitoring tools**, including anomaly detection, drift detection, and early-warning indicators for disruptions in highly dynamic and heterogeneous environments.
  - **Assess robustness under challenging and extreme scenarios**, such as adverse weather, lighting variability, unexpected traffic events, or special-event conditions.
  - **Enable on-board or edge-level deployment** by optimizing the pipeline for lightweight computational environments, focusing on inference time, memory usage, and energy constraints.
  - **Validate operational performance through field trials** and comparative analysis with existing systems, ensuring readiness for integration in real traffic management workflows.

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

  - **Months 1–3 – Consolidation and Optimization of the Existing Chain**
  - The methodology involves iterative development and testing of vehicle detection algorithms (e.g., YOLO) and fine-tuned tracklets association, addressing video stabilization challenges, and refining vehicle tracking systems.
  - Refinement of the YOLO + DeepSORT pipeline using the output of the first postdoctoral work.
  - Optimization for reduced inference time, memory footprint, and tracking stability.
  - Preliminary deployment tests on lightweight hardware (UAV-class GPUs/NPUs).

  - **Months 4–6 – Development of Real-Time Traffic Indicators and Dashboard**
  - Implementation of fast trajectory reconstruction modules suitable for online computation.
  - Derivation of real-time traffic indicators (flow, speed, headways, stability metrics) and integration in a dash.
  - Calibration and validation against offline benchmarks and controlled datasets.
  - Construction of an end-to-end pipeline combining detection, tracking, reconstruction, and indicators.

  - **Months 7–9 – Resilience-Oriented Monitoring and Anomaly Detection**
  - Design of anomaly- and drift-detection algorithms to identify sudden changes or disruptions.
  - Testing under dynamic and heterogeneous environments (varying densities, mixed traffic).
  - Integration of context-aware adaptations for special-event or irregular traffic regimes.

  - **Months 10–12 – Stress Testing and Validation under Extreme Conditions**
  - Evaluation under adverse weather, low visibility, non-standard trajectories, or incident scenarios.
  - Real UAV field trials with real-time indicator computation and on-board processing tests.
  - Final validation, documentation, and preparation of a deployment-ready prototype.
  - Joint wrap-up report and scientific dissemination in collaboration with NIT Calicut.

Candidate profile

- Indian candidates or candidates with a research experience in India are eligible; French candidates are not eligible
- No competences in French language is required
- Candidate competences : The candidate must demonstrate strong expertise in UAV technologies, computer vision, and algorithm development, with proven familiarity with vehicle detection and tracking methods (e.g., YOLO, DeepSORT, or equivalent). Solid understanding of traffic management systems is expected. Additional competence in real-time data processing, embedded or edge-device computation, and performance evaluation frameworks will be appreciated.

- Candidate know-how : The candidate should possess hands-on experience with UAV video data analysis and the development of real-time or near real-time software solutions. Strong skills in data analysis, trajectory processing, and the computation of traffic indicators are essential. Practical knowledge of resilience-oriented analytics—such as anomaly detection, drift detection, monitoring under disruptions, or evaluation in heterogeneous and extreme conditions—will be considered a significant asset. Experience in deploying or optimizing algorithms on resource-constrained hardware (e.g., embedded GPUs or UAV onboard processors) is particularly valued.
- Expected starting date: May 2026

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. A copy of Passport
v. International curriculum vitae (max 2 pages)
vi. Two letters of recommendation: one from any Indian institution and one from the French institution planned to host the candidate –mandatory- (max 2 pages)
vii. All should be submitted within 1 pdf file of no more than 10 pages.

Applications should be submitted to the following email address: msi@institutfrancaisindia.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.