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# Evaluation of an occupancy sensor at the Lançon-de-Provence toll gate

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# Context and Objectives

- **HOV (High Occupancy Vehicle) lanes promote sustainable mobility**
- **French laws (TECV, LOM) support carpool lane deployment and enforcement**
- **Ensuring compliance with HOV rules requires reliable occupancy detection**
- **Objective: Evaluate the performance and limitations of Cyclope.ai's sensor in real conditions**



# Methodology

**Site: Lançon-de-Provence toll gate  $\approx$  50,000 vehicles/day**

- **Methodology on 2 phases:**
    - Phase I: 210 vehicles (calibration)
    - Phase II: 1213 vehicles (evaluation)
  - **Data collected:**
    - Reference: sensor outputs vs. human-reviewed images
    - Contextual: weather, vehicle types, visibility
- **Key indicators: Detection Rate (TDE), Visibility Rate (TVI), True/False Positive Rates**





# Main Results

- **Detection Rate (TDE): 97.6%**
- **Visibility Rate (TVI): 87%**
- **HOV2+:**
  - **True Positives: 98.8%**
  - **False Positives: 3.7%**



➤ **Reliable performance for semi-automated enforcement**



# Identified Limitations

- **HOV3+: Lower performance, higher uncertainty**
- **Light conditions (intense sunlight): image saturation errors**
- **Vehicle features: Tinted windows, objects obstructing view**
- **Occasional vehicle classification issues**



# Comparison with Other Systems

- Cyclope.ai sensor ranks among the first top 3 evaluated systems
- Strong image clarity even with small vehicle windows
- Outperforms others in most evaluation scenarios

	TVI	VP	FP	TDE	SCORE
	83,16 %	34,91 %	32,07 %	79,94 %	15,16 %
	83,96 %	91,29 %	11,48 %	95,64 %	73,92 %
	88,71 %	92,86 %	6,09 %	94,99 %	78,68 %
	80,00 %	95,10 %	7,72 %	95,00 %	79,20 %
	87,12 %	98,00 %	2,19 %	93,77 %	84,29 %
Cyclope.ai	86,97 %	98,76 %	3,66 %	97,58 %	90,60 %
	85,45 %	97,14 %	2,56 %	98,27 %	91,40 %



# Improvement and Future Prospects

- **Algorithm enhancements:**
  - - Enrich training sets (e.g. inclined or hidden passengers)
  - - Add contextual filters (e.g. tinted glass detection)
- **Optimize flash/camera positioning for better angles**
- **Performance gains now require significant effort (asymptotic returns)**



# Conclusions

- **Excellent performance for HOV2+ occupancy detection**
- **Limitations under complex conditions (HOV3+, sunlight)**
- **Cyclope.ai shows strong potential for broader deployment**
- **Further real-world integrations are foreseen**



# THANK YOU!



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