Enhancing Safety and Reliability of Object Detection in Aerial Imagery through Explainable AI

End-of-Study project proposal for computer science student or similar

When: from March 2025 (6 months)

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Where: German Aerospace Center DLR (Germany) in cooperation with Digital Research Center of Sfax (Tunisia)

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Object detection in aerial imagery plays a vital role in many applications, such as traffic monitoring, autonomous driving and disaster relief. Ensuring the safety and reliability of AI models used in these contexts is critical, as decisions based on detection results can have significant real-world consequences. This internship will explore the emerging field of explainable AI (XAI) in aerial object detection, helping to better understand the strengths and limitations of current AI models. By focusing on explainability, the outcome of the internship will help improve the reliability of AI-driven decisions, ultimately contributing to safer and more trustworthy systems.

Steps:

1. **Literature Review**: Conduct a comprehensive review of current object detection algorithms in aerial imagery, with a focus on safety, reliability, and existing XAI approaches.
2. **Algorithm Analysis**: Analyze object detection algorithms for vulnerabilities and safety concerns, using both qualitative and quantitative methods, particularly in relation to XAI techniques.
3. **Solution Development**: Propose and develop potential solutions to address the identified vulnerabilities in object detection algorithms. Focus on integrating explainable AI techniques to enhance the transparency, robustness, and safety of the models in aerial imagery applications.

Required Qualifications	- Solid background in Computer Science, Computer Vision, Signal Processing or a related discipline - Programming experience in Python - Familiar with Machine Learning and Deep Learning approaches - Experience with Pytorch or Tensorflow frameworks - Fluency in English (written and spoken) is needed
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Monocular image based 3D Reconstruction of Buildings with attributes

End-of-Study project proposal for computer science student or similar
When: from March 2025 (6 months)

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Where: German Aerospace Center DLR (Germany) in
cooperation with Digital Research Center of Sfax (Tunisia)

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3D reconstruction of buildings from single remote sensing data presents a challenging task, requiring the extraction of geometry, textures, and physical attributes to produce accurate and detailed 3D representations. Such representations are critical for applications like urban density analysis and building arrangement, where remote sensing images can reveal the spatial distribution of structures, enabling classification into residential, commercial, or industrial zones based on size, shape, and proximity. Moreover, this process supports the generation of **Level of Detail 2 (LoD2) models**, which incorporate more intricate features such as roof structures and external building details, surpassing basic shapes.

The goal of this internship is to develop an accurate and robust 3D reconstruction pipeline capable of producing **LoD2 models**, which will capture not only the geometry and appearance but also key structural and material attributes of buildings from monocular images. These models will be enriched with building attributes (e.g., material properties and design features) generated using **Large Language Models (LLMs)**, providing a comprehensive understanding of each building's characteristics.

This research involves a thorough review of existing methods, identifying their limitations and opportunities. The primary task is to develop and evaluate a novel deep-learning-based approach using benchmark datasets, culminating in the generation of high-quality and attribute-rich LoD2 models.

Required Qualifications	- Solid background in Computer Science, Computer Vision, Signal Processing or a related discipline - Programming experience in Python - Familiar with Machine Learning and Deep Learning approaches - Experience with Pytorch or Tensorflow frameworks - Fluency in English (written and spoken) is needed
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