

## Master's Thesis Position - Synthetic Training Data Generation for Deep Learning-Based Building Damage Assessment from Optical Remote Sensing Imagery

### Context & Motivation

**Rapid and accurate building damage assessment (BDA)** from satellite and aerial imagery is critical for effective disaster response. At the German Aerospace Center (DLR), we develop deep learning-based BDA methods targeted for deployment in operational contexts with humanitarian partners, including the World Bank, the World Food Programme, and the German Red Cross, enabling responders to prioritize rescue efforts and allocate resources efficiently.

However, **state-of-the-art deep learning approaches for BDA are constrained by the limited availability of high-quality labeled training data.** Per-pixel ground truth annotations for post-disaster imagery are scarce, expensive to produce and geographically biased, limiting model generalization, particularly for underrepresented disaster types and regions.

**Synthetic 3D scene generation** offers a promising path to overcome these limitations by providing pixel-perfect annotations at arbitrary scale, including modalities that are infeasible to label manually, such as building height maps.

### Thesis Objectives

The goal of this master's thesis is to advance the generation of synthetic training data for deep learning-based BDA. Specifically, the candidate will:

- **Develop a deep learning algorithm for 3D building damage scene generation.** Design and implement a model capable of synthesizing realistic 3D post-disaster scenes across diverse disaster types. The generated scenes should exhibit physically plausible structural damage patterns and debris fields, conditioned on environmental context and disaster type, at a quality level sufficient for downstream model training.
- **Evaluate scene realism and downstream task utility.** Benchmark the proposed approach against DLR's existing 3D synthetic data pipeline. Systematically assess the quality of generated synthetic data by training state-of-the-art deep learning models for BDA on controlled combinations of real and synthetic data. Quantify the contribution of synthetic data to model performance and evaluate against established BDA datasets.

### Your Profile

We are looking for a highly motivated, high-performing Master's student with:

- Solid theoretical and practical experience in computer vision and deep learning, demonstrated through coursework and ideally through prior projects or seminar work.
- Proficiency in Python and modern deep learning frameworks (PyTorch preferred).
- Familiarity with one or more of the following is a strong plus: generative models, 3D Gaussian Splatting (3DGS), 3D rendering and simulation environments (Blender, Unreal Engine, or similar), remote sensing image analysis.
- Good communication skills and proficiency in English (spoken and written).



## What We Offer

- An impactful research project at the intersection of remote sensing, deep learning, and humanitarian applications, embedded in an active research group at **DLR's Earth Observation Center in Oberpfaffenhofen**.
- Access to high-performance computing infrastructure and proprietary datasets.
- The opportunity to contribute to work with real-world operational impact through DLR's partnerships with the World Bank, WFP, and the German Red Cross.
- Supervision and mentorship oriented toward a peer-reviewed publication.
- **Compensation according to public service wage agreements (TVöD Bund, E5 for Master's students).**

## How to Apply & Contact Details

To apply, please submit the following documents:

- Curriculum Vitae
- Cover letter detailing your motivation
- Transcript of records

Please send your application documents to:  
Sebastian Gapp - [sebastian.gapp@dlr.de](mailto:sebastian.gapp@dlr.de)

We look forward to getting to know you!