FEARS 2024 - Live Demonstration Setup

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Demonstration Overview

This demonstration will showcase the process of extracting 3D models of insects from CT scans using Python scripts and Blender 3D software. These 3D models are utilized for electromagnetic simulations in Sim4Life, demonstrating the integration of biological data with advanced simulation tools.

The demonstration aims to benefit researchers interested in working with CT scan data, providing a comprehensive overview of the pipeline and practical applications. The CT scan material used for this demonstration is openly accessible in public repositories, facilitating replication and collaborative research.

Required Equipment and Setup

- **Equipment Provided by the Presenter:**
  - Laptop
- **Equipment Requested:**
  - Computer screen
  - Power cords for both the computer and screen
  - One table and one chair

Additional Information

To supplement the demonstration, a poster has been submitted according to the conference requirements.

3D models available on the ETAIN Project Sketchfab page will be used to guide the demonstration and illustrate key points.

Additionally, a related presentation video from the Blender Conference 2024 in Amsterdam can be accessed for further context: Blender Conference 2024 - Amsterdam.

Contact Information

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From CT Scans to 3D Models: A Comprehensive Approach for Insect-Based Research

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Introduction

Insects are essential to ecosystems but may be impacted by RF-EMF exposure from telecommunication networks as they advance from 4G to 5G [1]. This project establishes a workflow to transform insect CT scans into 3D models, supporting applications like RF-EMF simulations to assess potential biological effects [2].

Goals

The primary objective of this project is to establish a versatile workflow for transforming insect CT scans into accurate 3D models, addressing challenges like missing parts and irregular positioning. While EMF simulations serve as one use case, the focus is on creating a flexible pipeline compatible with various research tools using free software.

Methodology

We utilized Blender, a free and open-source 3D software, combined with custom Python scripts to process the CT scan images of the samples.

The CT scan images were loaded into Blender, as demonstrated in **Figure 1**, where the conversion process from scan to a 3D model in STL format is illustrated.

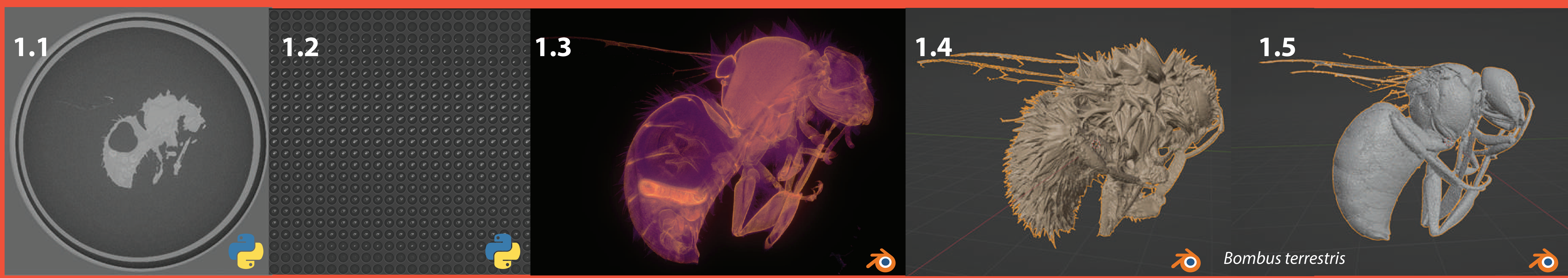

Figure 1:

1.1 CT scan of the bumblebee, *Bombus terrestris*, obtained from the Centre for X-ray Tomography at Ghent University.

1.2 Python-Generated CT Grid: A computational grid created in Python, based on the original CT scan data, to structure the 3D model.

1.3 Volume Rendering in Blender: A color-enhanced volume rendering performed in Blender. Note: colors are artificial and added for visual clarity.

1.4 Unfiltered Raw Mesh: The initial raw mesh generated directly from the CT scan data, shown without any filtering or adjustments.

1.5 Filtered Mesh: The refined mesh produced after applying filtering techniques to improve model quality and remove artifacts.

Subsequently, **Figure 2** highlights the processing steps within Blender to refine the 3D model, ensuring its suitability for electromagnetic simulations.

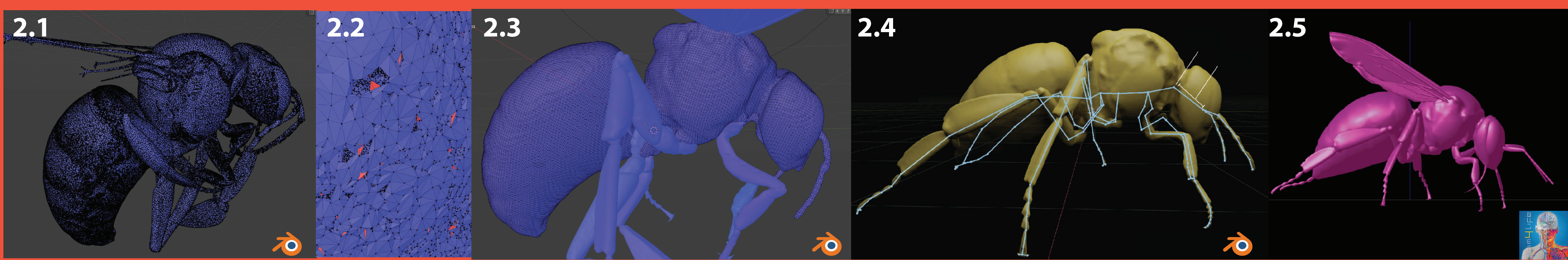

Figure 2:

2.1 The model's face count must be decimated to improve performance and allow easier manipulation.

2.2 Close-up of the mesh, highlighting areas requiring hole repair and topology adjustments to achieve a watertight model suitable for simulations.

2.3 Mesh Post-Repair: The mesh after applying the remesh modifier. Damaged areas, such as the wings, were reconstructed and refined using sculpting tools for a more accurate model.

2.4 Rigging with Armature and IK: An armature with bones applied to the model for rigging. The insect's posture was adjusted using the inverse kinematics (IK) feature to ensure realistic positioning.

2.5 Exported for Simulation: The final model, exported in STL format, loaded into Sim4Life for electromagnetic simulations.

Results

Using the generated 3D workflow, a 26GHz electromagnetic simulation in Sim4Life demonstrated RF-EMF interaction with insect surfaces.

The model was then imported into Blender for more flexible manipulation.. (Figure 3).

Figure 3: Simulation Results in Sim4Life: 26GHz Surface Model.

Workflow Access

The workflow and 3D models are available for viewing and download on Sketchfab.

sketchfab.com/etainproject

References

[1] Thielens, et al. Scientific Reports 8(1), 3924, 2018. [2] Thielens, PE 690.021, 2021, doi: 10.2861/318352.

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