Deliverable summary D3.5

Application of deep learning for symptom identification in trees

Project acronym:	**HOMED**
Project full title:	**Holistic Management of Emerging forest pests and Diseases**
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Duration:	**48 months**
Project coordinator:	**Herve Jactel (INRA)**
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WP leader:	**CNR**
Lead beneficiary:	**TPZF**
Partners involved:	**IEFC, INRAE, ISA**
Version:	**01**

Dissemination Level	
PU Public	**PU**
CI Classified, as referred to Commission Decision 2001/844/EC	
CO Confidential, only for members of the consortium (including the Commission Services)	

1. Summary

The HOMED project aims at developing a full panel of scientific knowledge and practical solutions for the management of emerging of native and non-native Pests and Pathogens (PnPs) threatening European forests.

The work reported here was part of Work Package 3, which focuses on the development of new prevention and detection tools for emerging and invasive pests and pathogens. Some of those tools can provide a huge amount of data or images that take time to analyse. New image processing methods have become available and mature enough to be tested for practical application in the project.

The main objective of this deliverable is to **test and develop artificial intelligence models** to automatically analyse images of PnPs symptoms. Telespazio France developed several operational services using AI-based models for private and public customers in the field of agriculture. Hence, we propose to develop new models for damage detection of forest pests and pathogens in European forest entities using our private Cloud processing platform. The partners involved to achieve this deliverable were mainly from IEFC, INRAE and ISA laboratories.

Images of PnPs damages might be acquired from several devices such as specific sensors, drones or other remote sensing cameras. Professionals and citizens through a smartphone application can also send those images. We decided to take advantage of this heterogeneity to investigate the contribution of deep learning approaches in distinguishing PnPs damage at different scales, namely seeds, leaves and entire tree images.

- Seed damages: X -ray scan of *Pinus Pinea* and *Pinus Pinaster* to detect seeds damaged by the invasive pine seed bug *Leptoglossus occidentalis*, using innovative tools for broad spectrum and specific identification and detection. AI models were successfully calibrated and validated for both species. X-ray scanning and AI detection processing can be proposed to producers and industrialists of this high added-value sector.
- Leaf damages: smartphone photos of horse-chestnut were collected using the Silvalert Application for post-border detection near entry points as a part of citizen's engagement. An AI-model was calibrated and showed promising results to detect and quantify the area damages on leaves. Nevertheless, more data is needed to be more specific (separating leaf mines from pathogen blotches) and to help end-users in distinguishing pathogens that cause similar foliar damages.
- Tree damages: Deep learning techniques were developed on aerial photography taken around possible entry points. It drastically reduces the visual control of the images of large areas and offers an operational and cost-effective method to improve forest health monitoring.

Another similar deep learning approach is also developed in Work Package 4 dedicated to the development of surveillance and delimitation tools for emerging and invasive pests and pathogens on trees and forests. It concerns the detection of Pine Processionary Moth nests at the tree scale in a forest stand using drone imagery and a range of spectrum bands. This work will take part in the dedicated deliverable D4.4 "On-board delimitation technologies for UAVs, using visual and chemical cues".

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