



Secteur des Sciences
et Technologies

Invitation à la soutenance publique de thèse de

Madame Jana JEZOVA

Ingénieur

Pour l'obtention du grade de Docteur en sciences agronomiques et
ingénierie biologique

« Towards microwave sensing of tree trunks : instrumentation and
radargram interpretation »

qui se déroulera

le mercredi 28 novembre 2018 à 16h30

Salle Jean-Baptiste Carnoy

Place Croix du Sud, 4-5

1348 Louvain-la-Neuve



UCLouvain

This thesis addresses the problem of non-destructive inspection of tree trunks using ultra-wideband microwave radar. In particular, the propagation of electromagnetic waves in cylindrical objects was analysed using a series of numerical experiments with different radar configurations, structures and media. In that respect, the open source software gprMax was used. It solves Maxwell's equations using the Finite-Difference Time-Domain (FDTD) method. Given the cylindrical geometry, we used the two-dimensional solution. These analyses contributed to the understanding of the reflections occurring in radar images obtained during the inspection of cylindrical objects. This had been only briefly addressed before in the literature. Furthermore, the advantages and disadvantages of each radar configuration were discussed. Afterwards, a new lightweight radar system with an original dielectric TEM horn antenna was developed for the specific application of tree trunk inspection. The new system was tested and validated for different configurations in the laboratory as well as in real outdoor conditions on trees of different species and states, with and without internal cavities. Tests were also carried out on concrete structures with rebar. An automated algorithm which reads and processes a binary ruler fixed on the investigated object was developed in order to provide precise and easy positioning. The experimental results demonstrated the good functioning of the developed tools. The influence of the bark roughness on the tree trunk radar data was finally studied using numerical, laboratory and outdoor experiments. This thesis resulted in new knowledge and methods for non-destructive testing of cylindrical structures using ultra-wideband microwave radars. It opens promising research and application avenues, in particular in the framework of tomographic reconstruction using full-wave inversion.

Membres du jury :

Prof. Sébastien Lambot (UCLouvain), supervisor

Prof. Marnik Vanclooster (UCLouvain), chairperson

Prof. Caroline Vincke (UCLouvain), secretary

Prof. Christophe Craeye (UCLouvain)

Prof. Raffaele Persico (Institute for Archaeological and Monumental
Heritage, Italy)

Dr Craig Warren (Northumbria University, United Kingdom)