

Non-invasive characterization of wood properties



Developing vibratory analysis methods

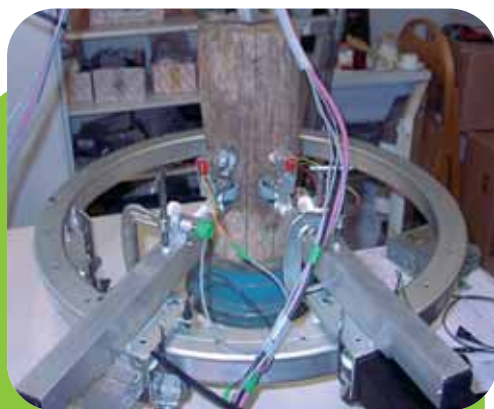
The technological properties of planted species often vary much more than those of natural forest species. To assess the technological performance of these woods, it is essential to determine their mechanical properties, which is often a time-consuming and costly operation. To pinpoint the variations in wood properties in a rapid and reliable way, CIRAD has developed an innovative method: analysing acoustic or ultrasound vibrations to detect defects, to qualify mechanically and to perform strength grading of woods. The field of application for this method is vast, from quality studies on standing trees to the detection of defects in unprocessed or processed products.

Assessing the quality of standing trees

Standing trees may have various types of internal defects—biological damage caused by fungi, knots, insect attacks or splitting—that foresters must detect and assess, as they directly govern the value of the wood. This value also depends on the physical and mechanical characteristics of the material, and it is essential to determine the variations in

those characteristics before felling the tree.

The tomograph (imaging apparatus) developed by CIRAD serves to assess those characteristics in a way that does not damage the tree and rapidly supplies relevant information, while being easy to use in the field. Standing trees are analysed using an ultrasound imaging technique that models the interaction between mechanical waves and the material.



© Ultrasound tomograph. © L. Brancheriau, CIRAD

Contact

Loïc Brancheriau
CIRAD
Production and Processing
of Tropical Woods
Research Unit
73 rue Jean-François Breton
34398 Montpellier Cedex 5
France

loic.brancheriau@cirad.fr

Characterization and mechanical classification of woods

CIRAD developed the **Bing method** of mechanical classification, which is based on studying vibrations in a piece of wood. In effect, there is a link between the mechanical properties and the vibratory behaviour of the material: impacts on a wood floor, musical instrument, wooden structure subjected to ground movements, etc.

The Bing system is a tool that measures the mechanical characteristics of pieces of wood. It determines the elastic characteristics (longitudinal elasticity module, transverse shearing) and non-elastic characteristics (internal friction associated with each resonance frequency) of any rigid material. The operation calls for a slender test piece, regular in shape, of which the support conditions are known. The test piece is subjected to longitudinal or transverse vibrations, which are recorded and analysed to determine the relevant characteristics.



Bing apparatus.
© L. Brancheriau, CIRAD



Noesys machine. © S. Paradis, CIRAD

The **Noesys machine** is an industrial wood classification system suited to small sawn timber production units (fewer than 20 pieces per minute). Its capacity to classify woods as part of the CE marking system implemented by the European Union was certified following a series of non-destructive and destructive reference tests.

Qualification of wooden structures

Wisis is a non-destructive method for in situ testing of wooden structures—poles, structural timbers—that may deteriorate as a result of excessive loads, fungal or insect attacks, or other external adverse effects.

It is a diagnostic tool, and makes it possible to examine wooden structures by analyzing acoustic vibrations. The detection method used is based on the modification in elastic wave spread resulting from wood deterioration.

CIRAD has registered Wisis® as a trademark. The Wisis software is protected.



Wisis apparatus.
© L. Brancheriau, CIRAD

Partners

- École nationale supérieure d'arts et métiers, Laboratoire bourguignon des matériaux et procédés, France
- Institut national des sciences appliquées de Lyon, France
- Laboratoire de mécanique et acoustique, University of Aix-Marseille, France
- Institut technologique Forêt Cellulose Bois-construction Ameublement, France
- Laboratoire de mécanique et de génie civil, University of Montpellier 2, France
- Istituto per la valorizzazione del legno e delle specie arboree, Consiglio Nazionale delle Ricerche, Italy
- Forest Research Institute of Ghana
- Centre de recherche forestière and Mohammed V University, Faculty of Science, Rabat, Morocco