SERVIÇO FLORESTAL BRASILEIRO

ITTO

ITTO-CITES Program

for Implementing CITES Listings of Tropical Tree Species

Side Event at the CoP17

3 October 2016, Johannesburg, South Africa

"Using Near infrared (NIRS) technology as a potential tool for the monitoring of mahogany trade"

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LPF

UnB

BRASIL GOVERNO FEDERAL

PROBLEM: Wood identification and origin

Actual Solution: **Wood anatomy (conventional methodology)**

Alternative solutions (some under development):

- ✓ **Wood anatomy using digital comunication: Brasil/Instituto Florestal (SP)**
- ✓ **Vision machine – Image capture and comparison with a reference in the database: USA/FPL**
- ✓ **Genetic – DNA barcoding: Alemanha, França, China**
- ✓ **NIRS – Brasil, Italy, China**

Reference: Best Practice Guide for Forensic Timber Identification – UNODC, 2016

NIRS MAHOGANY ID PROJECT

Specific Objectives:

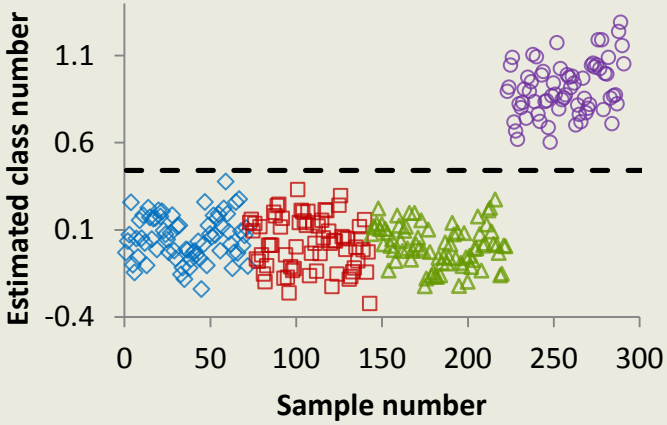
- **Transfer a successful timber identification methodology using a NIRS bench equipment to a portable device;**
- **Focus on *Swietenia macrophylla* (mahogany) and anatomically similar species (*Cedrela odorata*, *Carapa guianenesis*, *Micropholis melinoniana*) discrimination under field conditions;**
- **Discriminate *Swietenia macrophylla* wood according to the country of origin in America.**
- **Expand the spectra database to build a robust model for wood discrimination.**

MAIN STEPS

1. Wood identification

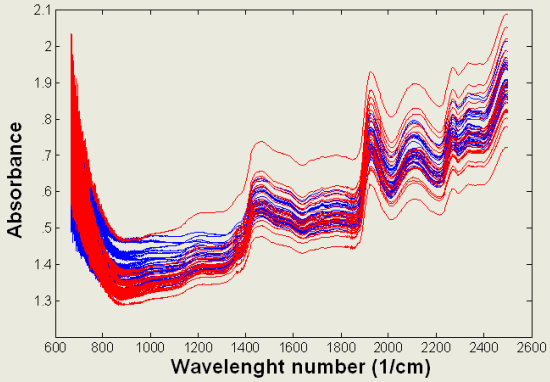
2. Surface preparation

3. NIRS spectrum



6. PLS-DA model for mahogany timber identification

5. Statistical model development



4. Building spectra databank

PILOT MISSIONS

(1) Brazil: Brasilia (DF)

(2) Brazil: Fazenda Seringal Novo Macapá (AC)

(3) Bolívia: Santa Cruz de la Sierra

(4) Guatemala: Petén

ACADEMIC CONTRIBUTIONS: 2 dissertations and 4 papers

IAWA Journal 37 (3), 2016: 420–430

NIRS IDENTIFICATION OF *SWIETENIA MACROPHYLLA* IS ROBUST ACROSS SPECIMENS FROM 27 COUNTRIES

Maria C.J. Bergo[1,2], Tereza C.M. Pastore[2,*], Vera T.R. Coradin[2], Alex C. Wiedenhoeft[3], and Jez W.B. Braga[1]

Universidade de Brasília
Instituto de Química
Programa de Pós-Graduação em Química

DISSERTAÇÃO DE MESTRADO

Transferência de calibração na discriminação de mogno e espécies semelhantes utilizando NIRS e PLS-DA

Maria Cecília Jorge Bergo

Orientador
Prof. Dr. Jez Willian Batista Braga
Coorientadora
Dra. Tereza Cristina Monteiro Pastore

Brasília, 2014.

Universidade de Brasília
Instituto de Química
Programa de Pós-Graduação em Química

DISSERTAÇÃO DE MESTRADO

Discriminação de madeiras similares por NIRS e PLS-DA considerando variações de temperatura e umidade

Rosylane Elaine Costa Lopes

Orientador
Prof. Dr. Jez Willian Batista Braga
Coorientadora
Dra. Tereza Cristina Monteiro Pastore

Brasília, 2015.

Near infrared spectroscopy (NIRS) as a potential tool for monitoring trade of similar woods: Discrimination of true mahogany, cedar, andiroba, and curupixá

Tereza Cristina Monteiro Pastore[1]*, Jez Willian Batista Braga[2], Vera Terezinha Rauber Coradin[1], Washington Luiz Esteves Magalhães[3], Esmeralda Yoshico Arakaki Okino[1], José Arlete Alves Camargos[1], Graciela Inês Bonzon de Muñiz[4], Otávio Augusto Bressan[4] and Fabrice Davrieux[5]

Holzforschung, Vol. 67, pp. 1–8, 2013

Assessment of total phenols and extractives of mahogany wood by near infrared spectroscopy (NIRS)

Allan Ribeiro da Silva[1], Tereza Cristina Monteiro Pastore[2,*], Jez Willian Batista Braga[1], Fabrice Davrieux[3], Esmeralda Yoshico Arakaki Okino[2], Vera Teresinha Rauber Coradin[2], José Arlete Alves Camargos[2] and Alexandre Gustavo Soares do Prado (*In memoriam*)[1]

Holzforschung, Vol. 65, pp. 73–80, 2011

IAWA Journal, Vol. 32 (2), 2011: 285–297

THE USE OF NEAR INFRARED SPECTROSCOPY TO IDENTIFY SOLID WOOD SPECIMENS OF *SWIETENIA MACROPHYLLA* (CITES APPENDIX II)

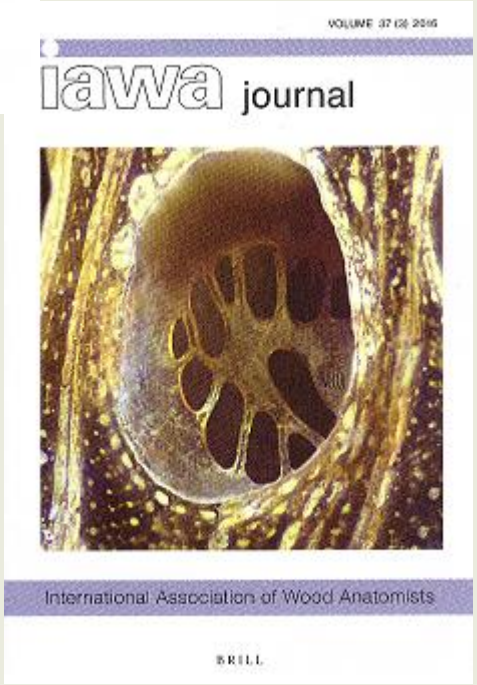
Jez Willian Batista Braga[1], Tereza Cristina Monteiro Pastore[2*], Vera Terezinha Rauber Coradin[2], José Arlete Alves Camargos[2] and Allan Ribeiro Silva[1,2]

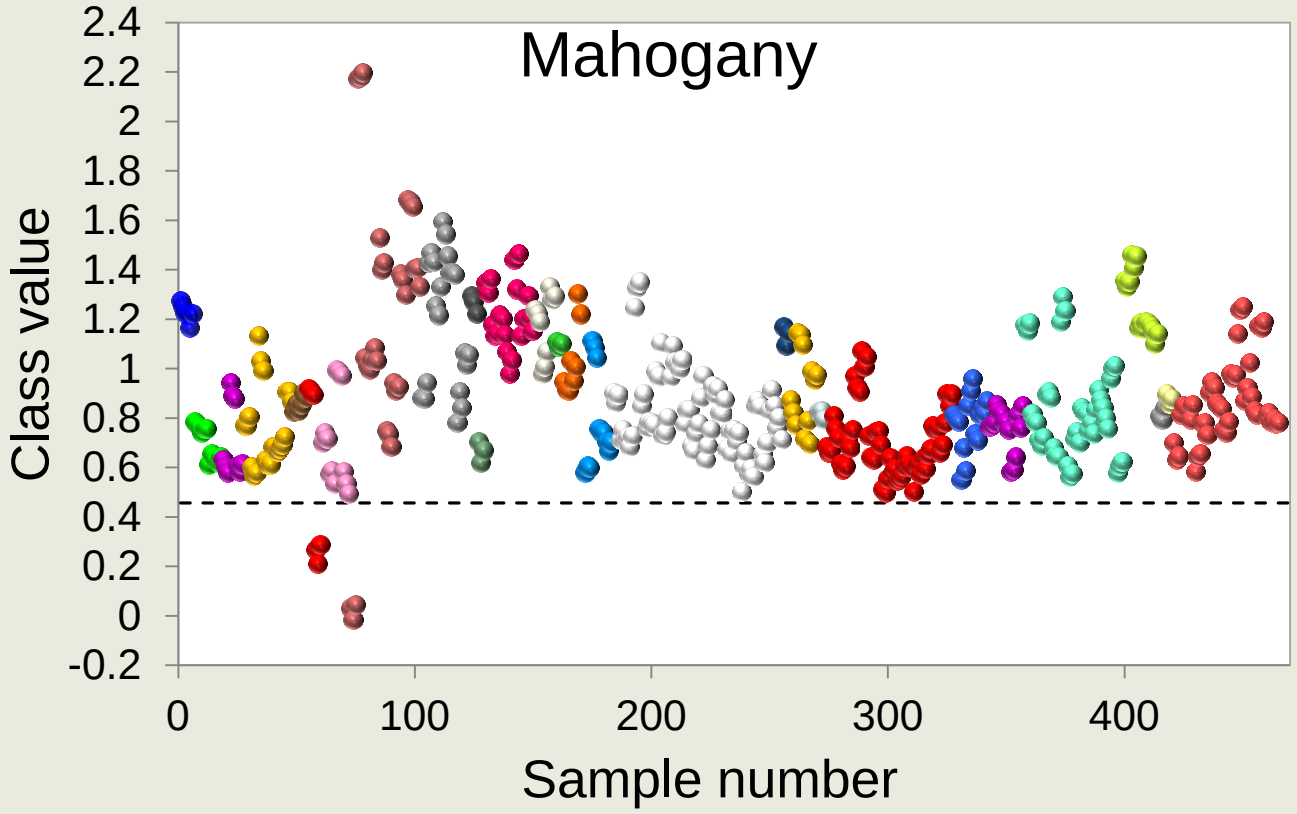
RESULTS: mahogany samples from 27 countries are correctely identified

IAWA Journal 37 (3), 2016: 420–430

NIRS IDENTIFICATION OF *SWIETENIA MACROPHYLLA* IS ROBUST ACROSS SPECIMENS FROM 27 COUNTRIES

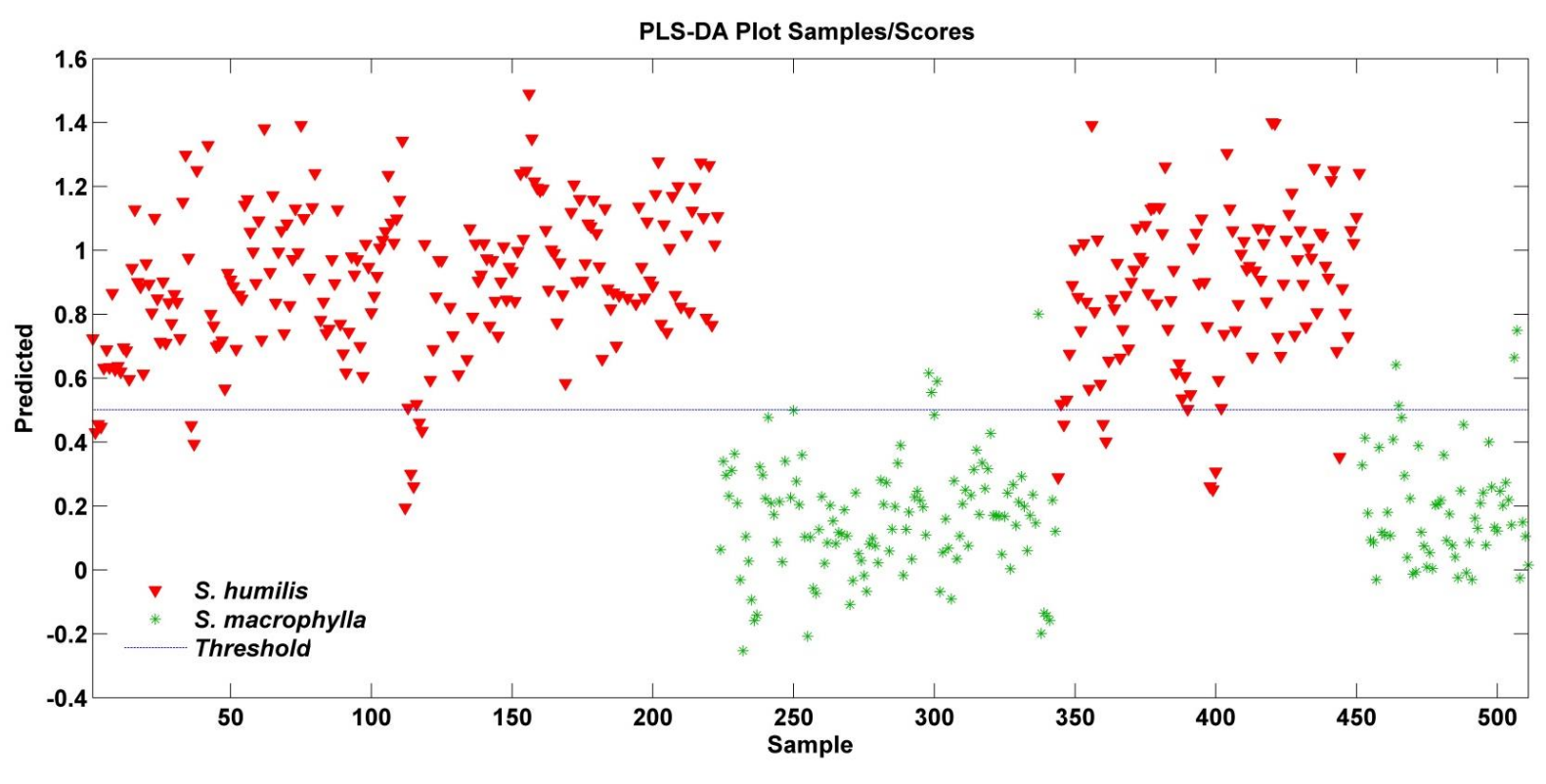
Maria C.J. Bergo[1,2], Tereza C.M. Pastore[2,*], Vera T.R. Coradin[2], Alex C. Wiedenhoeft[3], and Jez W.B. Braga[1]





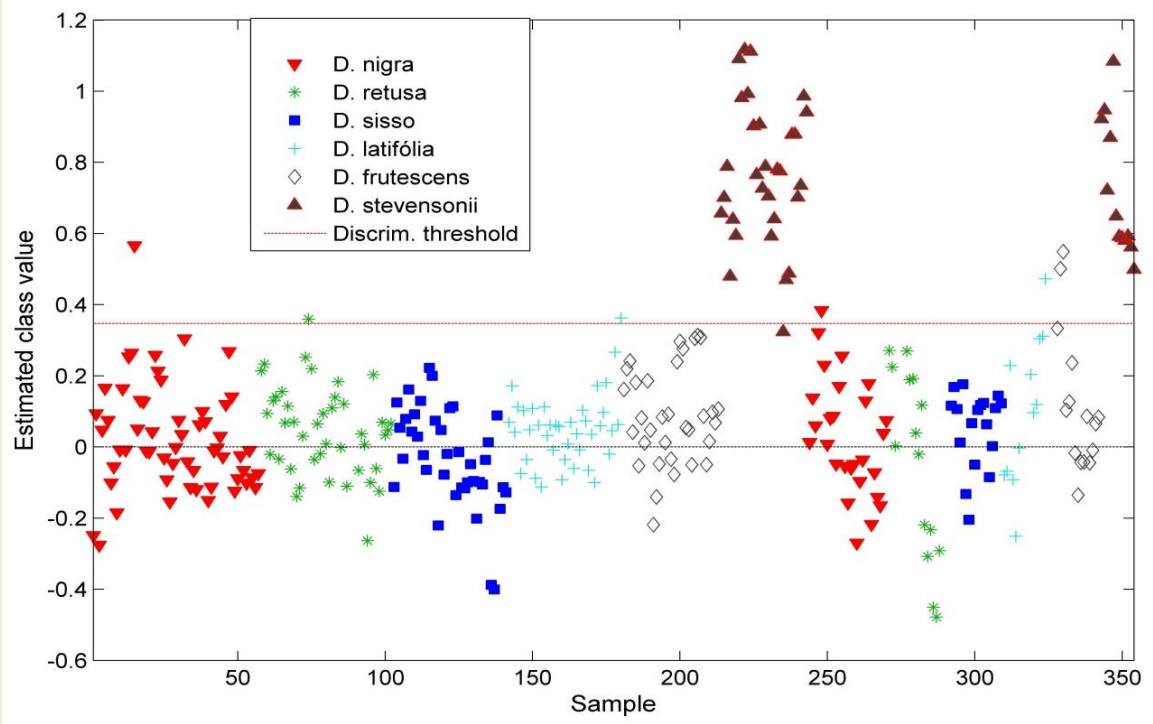
98 % samples were classified as mahogany;

Result: Swietenia macrophylla and S. humilis from Guatemala are discriminate



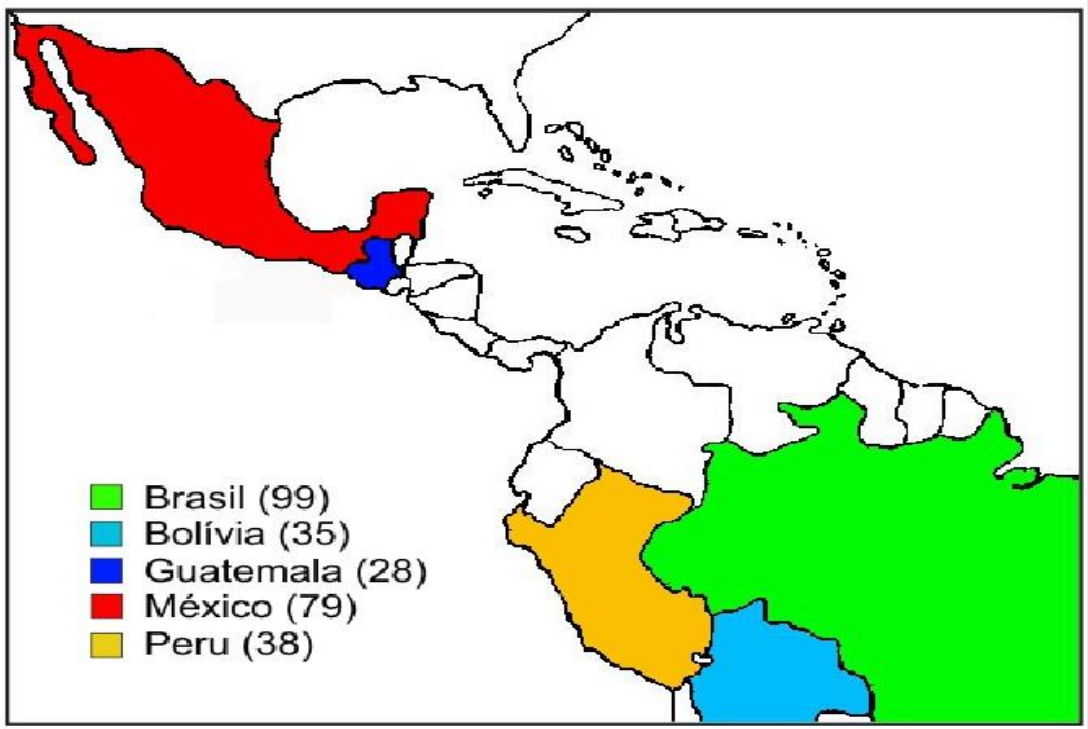
S. macrophylla **and** ***S. humilis*** **was separated with an Efficenty Rate of 86% .**

PRELIMINARY RESULT: Discrimination of six Dalbergia species



Species	Efficiency rate (%)
D. nigra	88
D. retusa	95
D. sisso	80
D. latifolia	62
D. frutescens	95
D. stevensonii	95

RESULT: identification of mahogany wood from five countries with portable device



Efficiency rate (%)				
COUNTRY				
Bolivia	Brazil	Guatemala	Mexico	Peru
100%	89%	97%	94%	99%

Advantages of NIRS

1. **Analyses is performed *in field* very quickly (<30s)**

2. **Portable devices are user-friendly and results obtained in real time are possible**

3. **Wood surface is easily prepared (plane, sand and clean)**

4. **NIRS can distinguish between wood of:**

    a) **different parts of a tree:** trunk, branches and fork
    b) **different species of the same family (Meliaceae):** mahogany, cedar and andiroba
    a) **different families:** mahogany (Meliaceae) and curupixá (Sapotaceae)

5. **NIRS is a non-destructive, reagent and waste free method.**

6. **The comparison of costs betwen wet chemistry analysis (conventional) and NIRS is very favorable: NIRS is 2X cheaper**

Some basic requirements:

1. **A large number of samples of each species must be available;**
2. **The participation of a specialized wood anatomist is essential to build a reliable model prediction;**
3. **The statistical model must be robust to enable a reliable discrimination of wood species;**
4. **Variable factors such as moisture and fiber orientation should be introduced in the chemometric model;**
5. **Models should be periodically reviewed and updated.**

CONCLUSIONS :

- NIRS associated with multivariate analysis is a reliable method for wood identification

- The method can be used in field conditions with high rate of correct classification (> 90% with portable devices)

- It was possible to identify the source or origin of the wood

- The method can be used for timber certification and illegal traffic control.

Team

Research:

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Thank you very much!

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