Machine vision wood identification: Xyl◎Tron

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Prior and current relevant projects

Funding Sources and Duration

- US Department of State (2011–2017)
- US Forest Service International Programs (2011–Ongoing)
- US Forest Service Forest Products Laboratory (2011–Ongoing)
- National Fish & Wildlife Foundation (2016–2018)
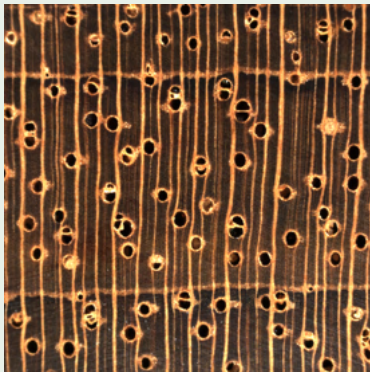
Prior and current relevant projects

Existing cooperators

- Dr. Hisashi Abe, Forestry and Forest Products Research Institute, Tsukuba, Japan
- Dr. Sandra Florsheim, Seção de Anatomia de Madeira, Instituto Florestal, São Paulo, Brazil
- Dr. Peter Gasson, Royal Botanic Gardens Kew, London, England
- Dr. Myrna Herrera Sosa, Laboratorio Forense de Maderas de la Universidad de San Carlos, Guatemala City, Guatemala

Prior and current relevant projects

Existing Cooperators

- Dr. Gerald Koch, Thünen-Institut für Holzforschung, Hamburg, Germany
- Dr. Carmen Marcati, Universidade Estadual Paulista, Botucatu, Brazil
- Dr. Flavio Ruffinatto, Turin, Italy
- Dr. Yafang Yin, Chinese Academy of Forestry, Beijing, China
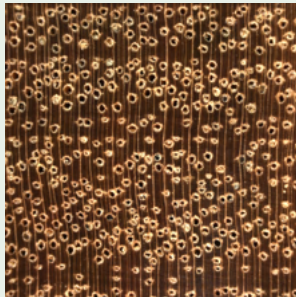
Prior and current relevant projects

Taxa under scrutiny

Commercially relevant Central American and
Brazilian hardwood species

- 60 families
- 197 genera
- 926 species
- 5202 unique specimen blocks
- 22795 utilized images
- Approximately one person year
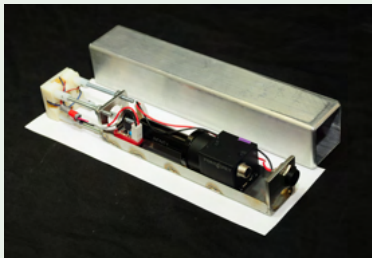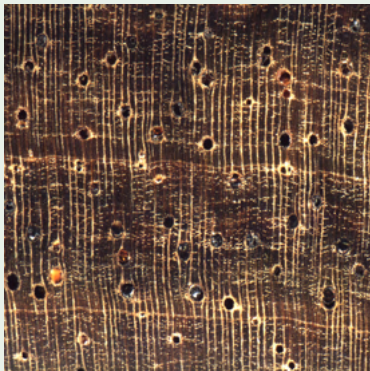
Species

Genus

Family

Order

Class

Phylum

Kingdom

Prior and current relevant projects

Open system for cooperation

- Utilize off–the–shelf hardware
- Utilize open source software
- Have an open reference image collection
- High–throughput
- Repeatable
- Easy–to–use

Methods and data open-access and publically available

- Reference image collection
- CAD drawings for XyloScope
- Source code

Prior and current relevant projects

What were challenges/successes observed?

- Porting machine vision research to wood species identification given the constraints of being field deployable and open source
  - Choosing the appropriate camera, lens, lighting
  - Choosing the appropriate software
  - Techniques utilized on other machine applications are not relevant to wood identification
- Preparation and imaging the existing reference image collection
- Learning the difference between vouchered and non vouchered specimens.

Prior and current relevant projects

What do you consider your biggest hurdles

- Small data set with large variation
- Access to vouchered specimens
- Resources to prepare the samples for imaging
- Rapid, repeatable field preparation
- Making the current image reference collection relevant to the future

Detailed Overview of Specific Project

Methods you used to generate your reference

- 10853 vouchered images
- 37 species images > 50 images per species
- Only 3 CITES species are in that list of 37
  - Cedrela odorata
  - Guaiacum sanctum
  - Swietenia macrophylla
- 774 samples of CITES species 180 vouchered

Species

Genus

Family
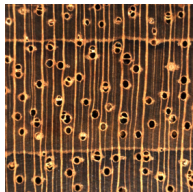
Order

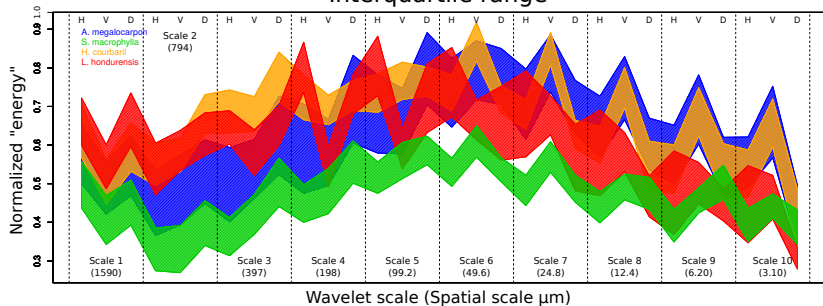Class

Phylum

Kingdom

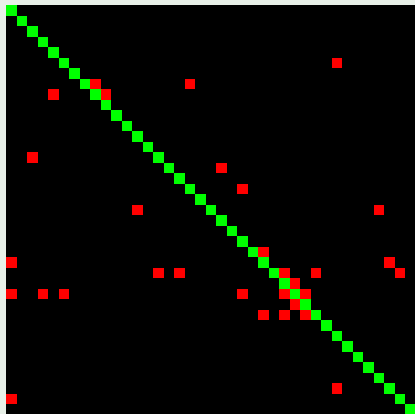# Specific analysis methods

Interquartile range

XyloTron summary

Confusion Matrix

For the 37 species above plus 2 more species of interest to Guatemala

- 3560 correctly classified images (diagonal green)
- 46 misclassified images (off diagonal red)
- 98.7% accuracy at identifying the **species**

Acknowledgements

LATEX with the BEAMER class

Questions?

Nothing in Nature is random. ... A thing appears random only through the incompleteness of our knowledge.

Baruch Spinoza