



**EUFAR Training Course**

# **Airborne Remote Sensing for Monitoring Essential Biodiversity Variables in Forest Ecosystems (RS4forestEBV)**

*Bavarian Forest National Park and German Aerospace Agency, Germany, 3-14 July 2017*

## Data fusion Hyperspectral & Lidar

*Ruben Van De Kerchove, VITO*



# Overview

- ▲ Intro data fusion hyperspectral-LiDAR
  - ▲ Hands – on
    - Mapping tree species
  - ▲ The DIARS toolbox
-

# Data Fusion

- ▲ Data fusion is the **integration** of two or more different datasets to form a new data utilizing a certain algorithm.
  - ▲ It can be **implemented at different levels**: at the **pixel** level, **feature** level, and **decision** level
-

# Pixel level fusion

- ▲ Pixel-level fusion fuses information from different images on a **pixel-by-pixel basis** to improve the performance
    - E.g. STARFM (MODIS/LANDSAT)
  
  - ▲ **LiDAR – Hyperspectral**
    - Tree crown segmentation
    - Shadow mask
    - BRDF correction
-

# Feature level fusion

- ▶ At feature-level fusion, features are extracted from multiple images, then **combined into a concatenated feature vector** and classified using a standard classifier.

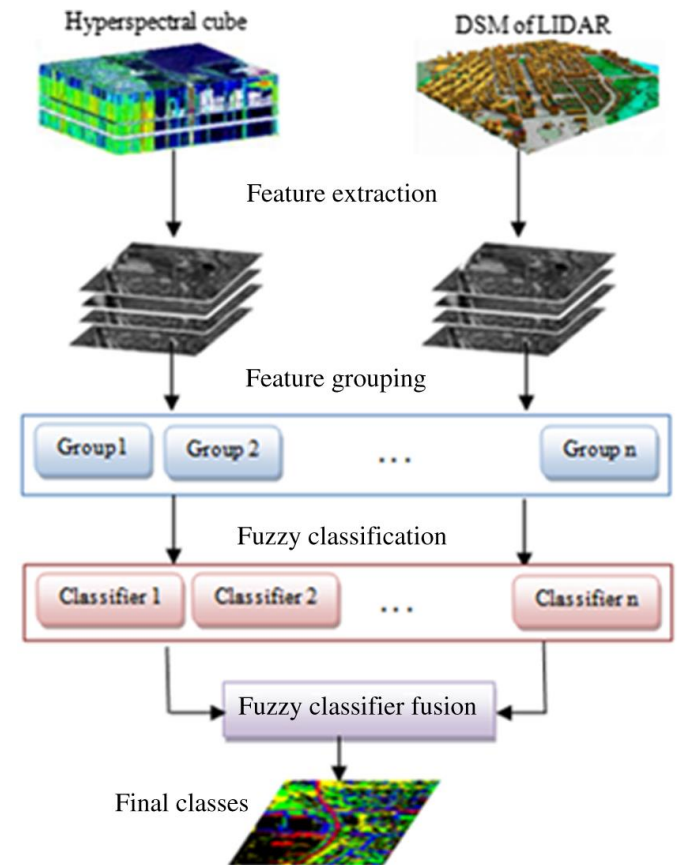
But also ...

- ▶ Feature level fusion **extracts various features**, e.g. edges, corners, lines, texture parameters, etc., from different data sources and then combines them into one or more feature maps that may be used instead of the original data for further processing.
-

# Decision Fusion

= classifier fusion, classifier combination, classifier ensemble, ...)

→ is the process of **combining the outputs of multiple classifiers** in order to achieve higher accuracy on a given classification task



# Decision Fusion

- Different fusion algorithms exist
    - simple arithmetic operations
    - complex combiners such as fuzzy integrals
    - Naïve bayes
    - Meta-classifier!
    - But most common: Weighted average
      - → output is weighted e.g. through user & producer accuracies per class
-

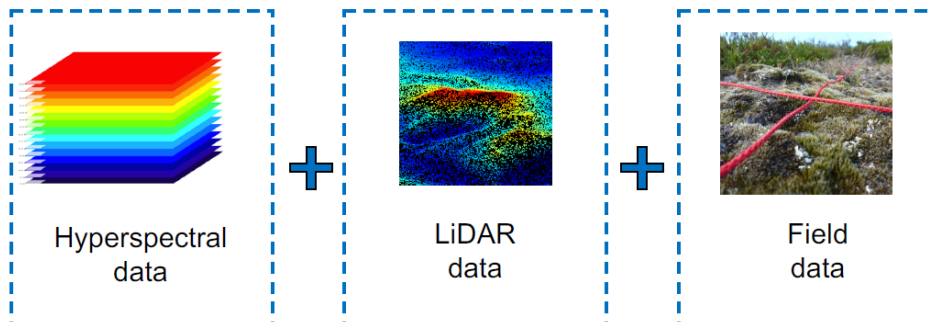
# Hands-on exercise

- Use of LiDAR and Hyperspectral for tree species mapping
    - Mapping based on a single dataset (either hyperspectral or LiDAR)
    - Feature level fusion → stack everything
    - Decision fusion
      - Max probability
      - Meta-classifier
-



# DIARS TOOLBOX

- ▲ A set of **tutorials** covering the different aspects of the DIARS project (mapping, modeling & impact assessment) using open source software will be released soon
- ▲ These will contain
  - The RS dataset (APEX & LiDAR), partly reduced
  - The full field dataset
- ▲ Keep an eye on your mailbox or the DIARS website <http://diars.vgt.vito.be/> !



Home	Data processing	Hyperspectral images
		LiDAR images
		Sampling design
	Applications	Mapping
		Modeling
		Impact assessment

# Thank you!!

Ruben Van De Kerchove  
Flemish Institute for Technological Research, VITO  
E-mail: [ruben.vandekerchove@vito.be](mailto:ruben.vandekerchove@vito.be)  
Tel.: +32 14 33 67 20