GENERATION OF URBAN OBJECTS SPECTRAL LIBRARY USING LABORATORY HYPERSPECTRAL IMAGER IN KAUNAS CITY (LITHUANIA)

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Context and goals

Context:

- Existence of many spectral libraries (ASTER, **Baldridge et al, 2009;** SLUM**, Kotthaus et al, 2014;** Santa Barbara Urban Spectral Library**, Herold et al, 2004**).

- The **availability** of the data not ensured.

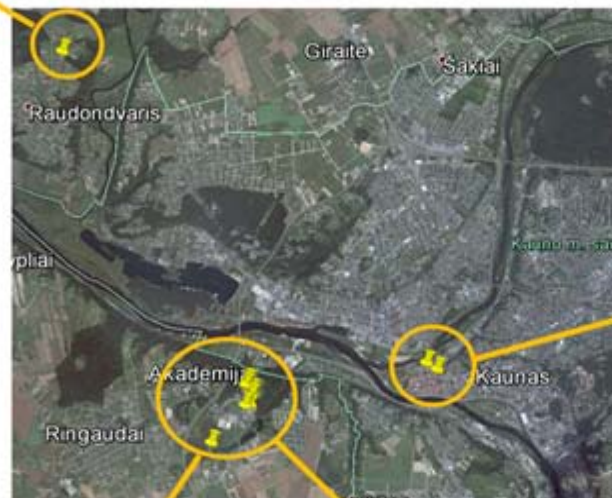- A **lack** of **urban materials** is noticed.

Goals:

- Create a **spectral library** of various **urban materials**.

- **Standardize** the spectral library, and follow existent **directives** (INSPIRE, CLC, etc) to classifies the materials.

- Create a tool for urban objects **recognition** and **characterization**.

Study zone

Kaunas (Lithuania)

Raudonvaris

Kaunas old town

Ringaudai

Samples collection:

1st sampling campaign:

- **July 2015**: concerned 3 district of Kaunas city: Old town, Raudonvaris, Ringaudai.

- Materials: urban vegetation, roofing's, paved, bare soil, asphalt (**32** materials collected and measured).

2nd sampling campaign:

- **April 2016**: roofing's sample from Kaunas University of Technologies (KTU, department of materials).

- Materials: roofing's (**20** materials collected and measured).

Superspectral Camera (Themis Vision):

Brand: Themis Vision VNIR400H (Themis Vision systems LLC).

Spectral Range: Vis-NIR, 400nm to 1000 nm.

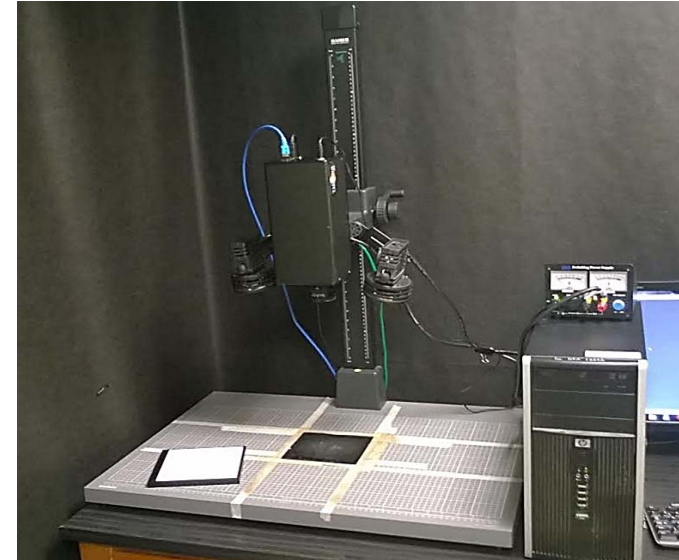Spectral resolution: 0,6nm
Sensor type: CCD.

Bands number: 955.

Light: 2 halogen lamps of 100W

Image Scan: line by line
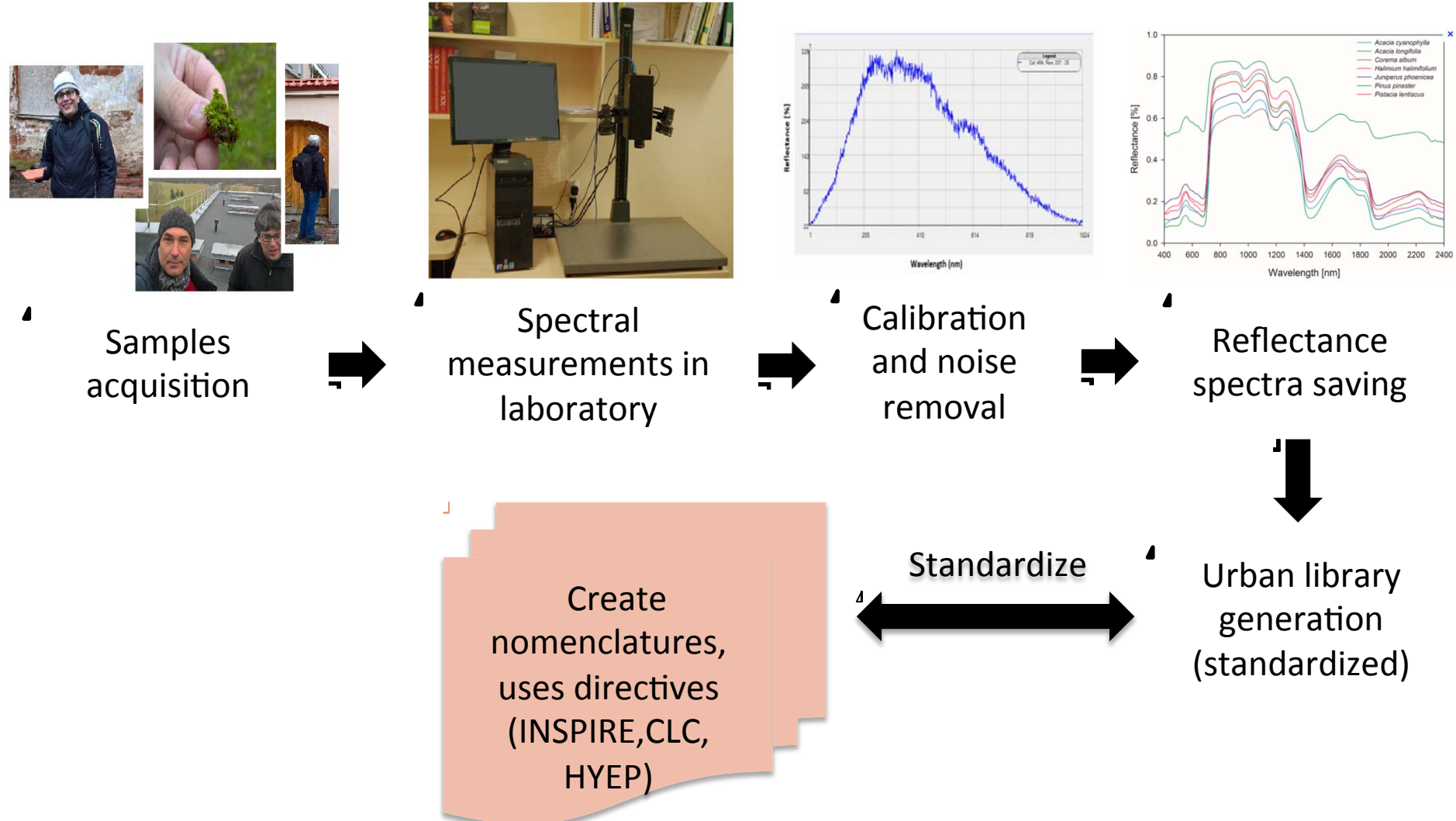
Measurements conditions: black room

Spectral Library acquisition

- **Spectral library** acquisition (Vis-NIR) in July 2015 of various urban materials in the city of Kaunas (Lithuania) updated in April 2016.

- **Roofing's**: painted steel, asbestos, tile, fibre cement, aluminum, old steel, bitumen.

- **Roads** : asphalt (old and new), paved (new and old), bare soil.

- **Vegetation**: grass, and various trees species (deciduous and coniferous).

- At the moment around **fifty** measured materials**.**

Spectral Library acquisition

Samples acquisition

→

Spectral measurements in laboratory

→

Calibration and noise removal

→

Reflectance spectra saving

↓

Create nomenclatures, uses directives (INSPIRE,CLC, HYEP)

← Standardize →

Urban library generation (standardized)

Materials

1st sampling campaign (July 2015):

- **Roads:** asphalt (new and old), pavements (new and old), stony roads (old town).
- **Roofing's**: tile, painted steel(red), old steel, asbestos, bitumen (new grey).
- **Bare soil**: clayey soil, black soil.
- **Vegetation**: Thuja, aspen, corylus avellana, lime glow, linden, mountain ash, chestnut, silver fir, maple, pines, red clover, fir, grass.
- **Various**: slabs, cement.

→ **Over 32** materials collected and measured.

Materials

1st sampling campaign (July 2015):

Vegetation

Roads

Roofing's

Bare soil

Materials

2nd sampling campaign (April 2016):

- **Roofing's**:
  - Tile: ceramic non painted.
  - Painted steel: brown (2 different brands).
  - Old steel: non painted.
  - -Aluminum.
  - Fibre cement: 7 different colors.
  - Asbestos:well preserved.
  - Asbestos: old.
  - Asbestos: old + lichen.
  - Asbestos (red painted)
  - Bitumen: 3 different textures.

→ Over **20** materials collected and measured.

Materials

2ⁿᵈ sampling campaign (April 2016):

Signal pre-processing

- Reflectance estimation, using a white reference panel (i.e. light reflection at 99%).

- Electronic noise removal, by lens covering (i.e. dark reference).

- Signal smoothing: using a Savitsky Golay filter, with a second order moments.

- Extract useful spectral range: 400nm – 1000nm, reflectance lower than 400nm is not considered.

Spectral extraction

- Each laboratory measurement gives an hypercube of 955 bands, the spectra of interest must be extracted from the hypercube manually.

- 5 spectra are extracted –at the moment- for each material: take into account spectral variability, and texture change (non-uniformity of the measured surface).

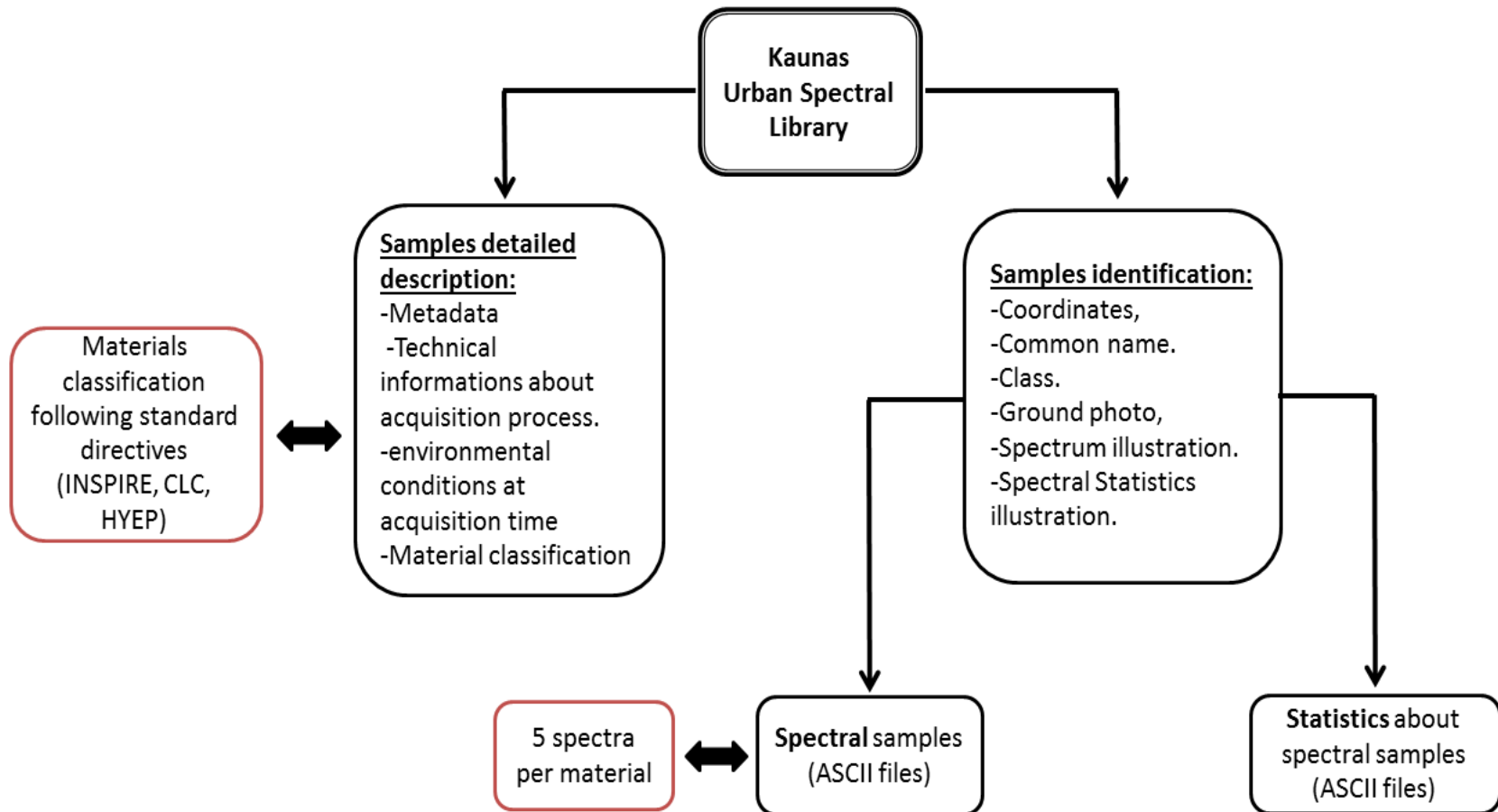- If possible, shadowed spectra are extracted for each material.

Spectral extraction
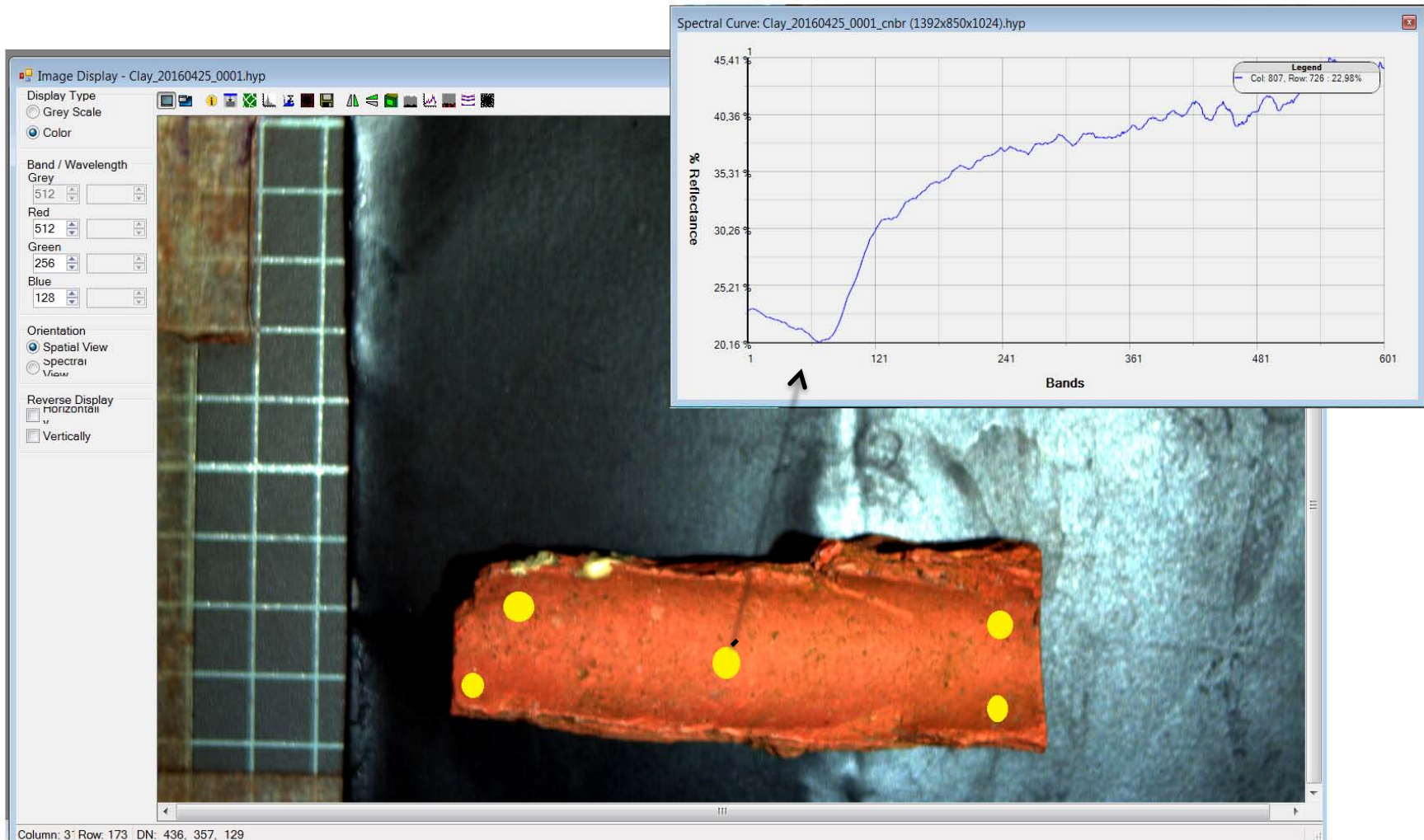
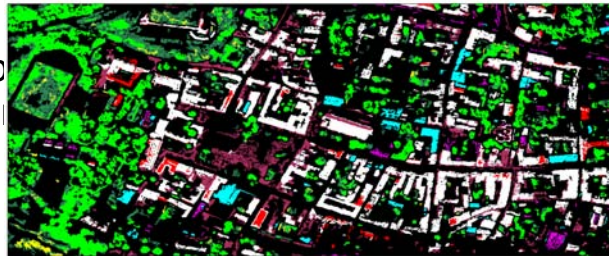Five spectral measurements are extracted for each material

Library standardization

Conclusion and futurs work

- An **urban spectral library** was built (samples from Kaunas, Lithuania) with over 50 urban materials.

- The library was **standardized** to facilitate the use and exploitation of the data.

- The **applications** related to the use of this library are multiple: urban objects classification and recognition, spectral variability studies, degradation detection, ect.

- This library **consolidate** the existing spectral libraries and offer new materials and new study zone compared to the existing.

- The library remind op‌‌ **dated** with other spectral measurements, the sta‌‌ied and improved for more practicality.

Thank you for your attention

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