Stand-off landmine detection using (hyperspectral) infrared imaging

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Outline

- What is hyperspectral?
- Applications to Mine Detection
  - SWIR
  - LWIR
- Drawbacks and alternatives

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What is hyperspectral?

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What is hyperspectral?

Let us look with our own eyes at 679nm (red) …

How many people do you see on the picture?

What is hyperspectral?

Now let us move to the near-infrared (942nm) …

How many people do you see on the picture?

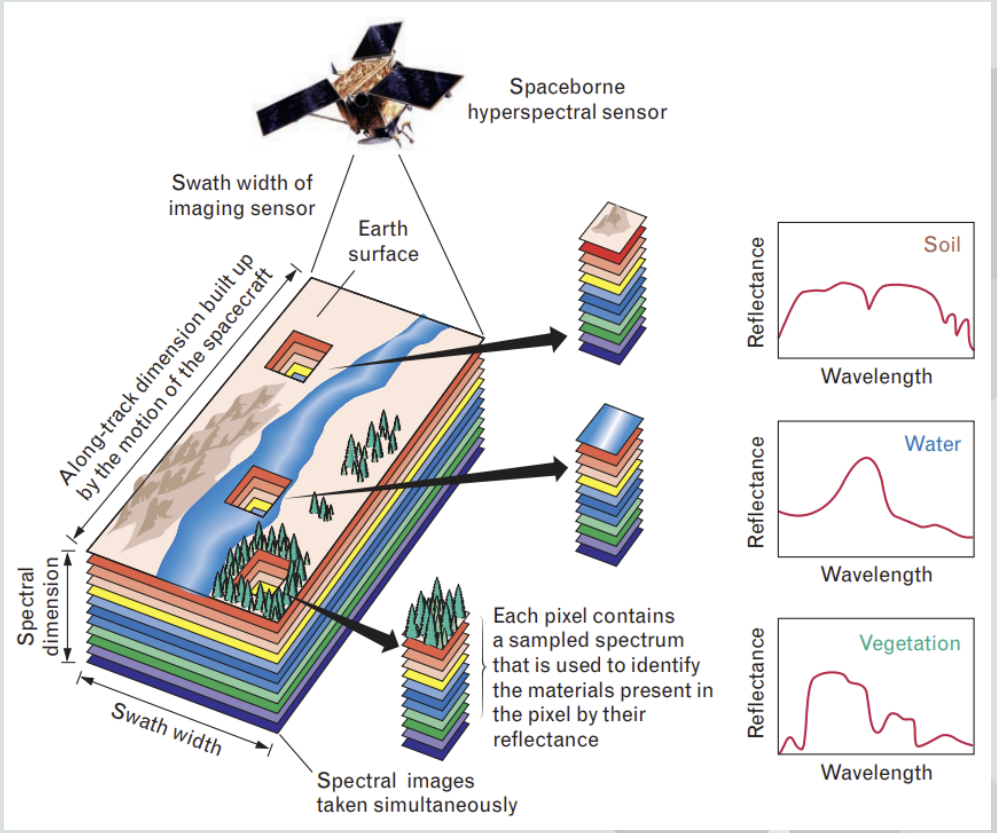
HSI principles in a nutshell

Hyperspectral sensors measure:

- Light emitted & reflected by as $f(\lambda)$
- Intrinsic property of material

- Applications:
  - Agriculture
  - Environmental studies
  - Geology
  - Food inspection
  - Camouflage denial
  - …

HSI principles in a nutshell



https://www.eoportal.org/other-space-activities/hyperspectral-imaging

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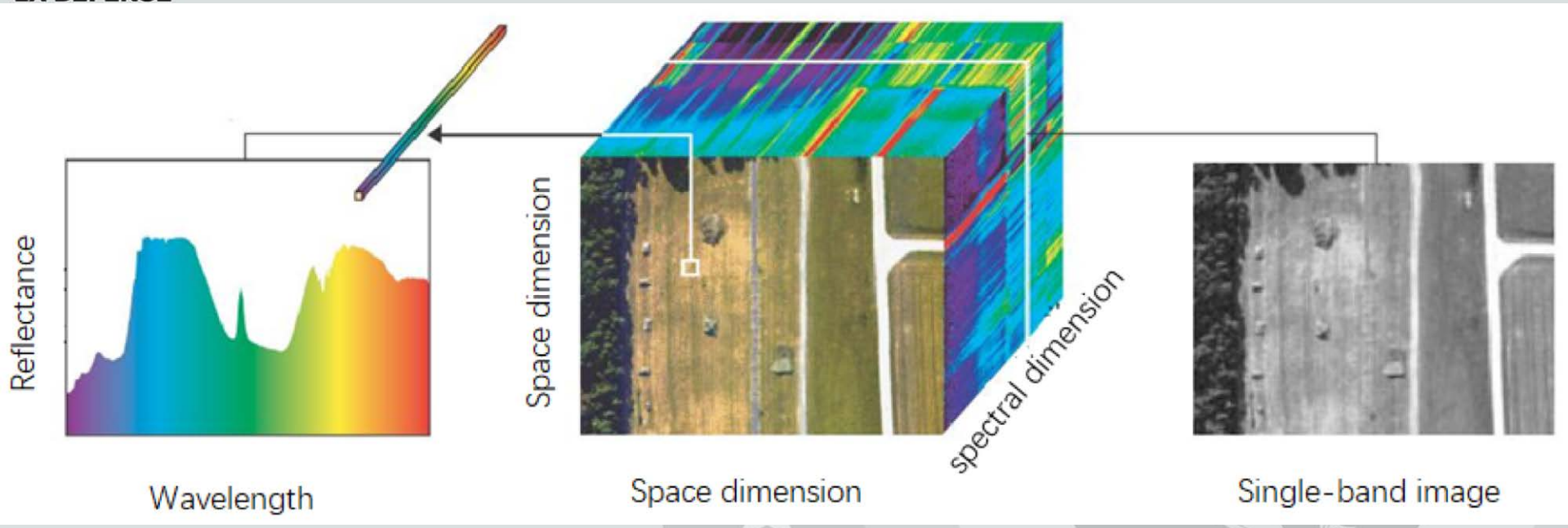

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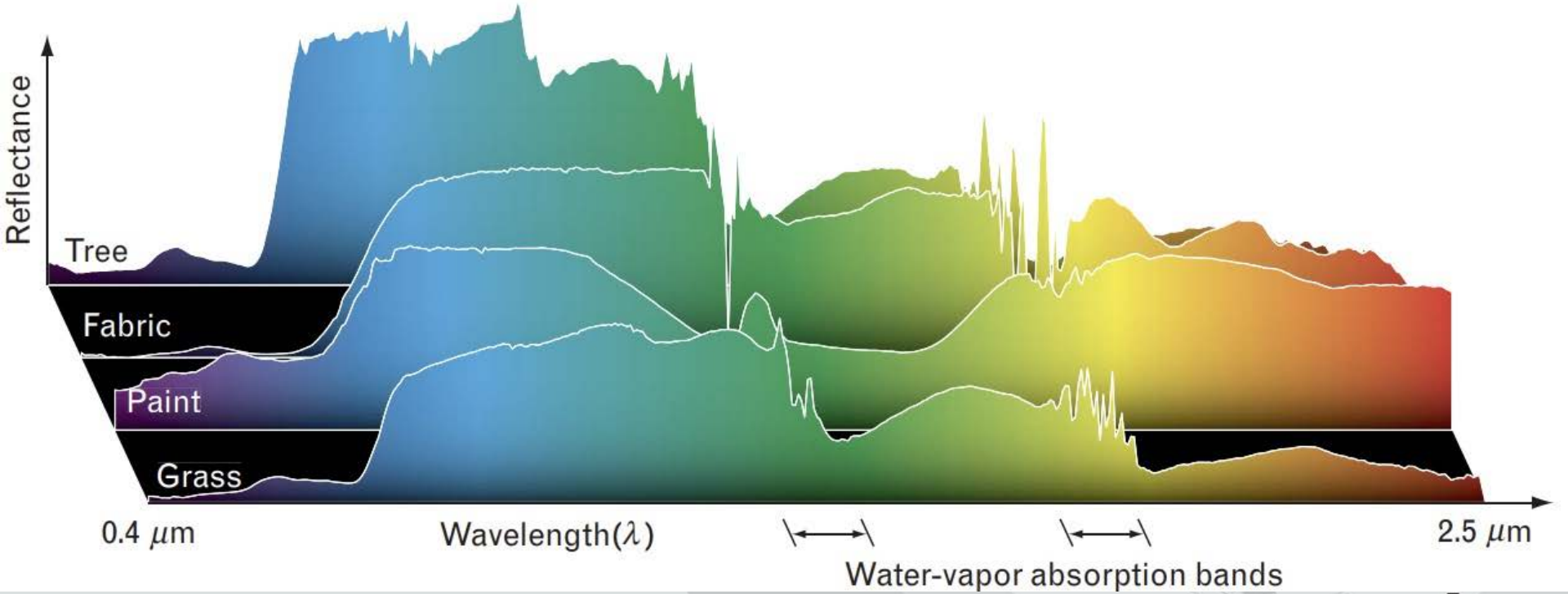

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Applications to Mine Detection

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Applications to Mine Detection

SWIR:

- Chemical properties of explosives around 1.6µm
- Soil disturbance:
  - Grain size, microshadows
  - Ephemeral
- Stress in vegetation
  - Roots, water, chemicals
  - Chlorophyll red edge (0.710 - 0.805µm)

Applications to Mine Detection

SWIR:

- Water
  - Puddles
  - Percolation
- Chemical properties of paint
  - Anthropogenic: hydrophobic
  - Rocks/soil: hydrophilic

Applications to Mine Detection

- LWIR:
  - Reststrahlen effect
    - Resonance effect with molecules
    - Quartz 8.0-9.5µm region
  - Thermal anomalies
    - Thermal inertia
    - Conductivity

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Drawbacks and alternatives

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Drawbacks

- Cost
- Amount of data → ML
- Interpretability
- Atmospheric effects / calibration
- Spectral/spatial resolution
- Penetration depth of IR

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Any Questions?

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