Remote Sensing Experiments: Summary for Oral Exam

GENERAL CONCEPTS & TECHNIQUES

Remote Sensing
- Definition: Capturing information about Earth's surface from satellites/sensors without physical contact.
- Why Use: To observe, analyze, and monitor land use, vegetation, water, etc.
- Effect: Provides visual and quantitative data of Earth's surface.

Satellite Image
- Definition: Image captured by a satellite sensor showing ground features.
- Why Use: Helps study natural and man-made features remotely.
- Effect: Shows reflectance values or pixel intensities.

Band
- Definition: A specific range of wavelengths in the electromagnetic spectrum.
- Why Use: Different bands highlight different surface features.
- Effect: Allows classification, vegetation analysis, water detection, etc.

Raster Image
- Definition: A grid of pixels, each representing a value like reflectance.
- Why Use: It's the basic format for satellite images.
- Effect: Enables spatial and spectral analysis.

IMAGE PROCESSING TECHNIQUES

Gray Conversion
- Definition: Converts RGB image to grayscale.
- Why Use: To simplify analysis by reducing to one channel.
- Effect: Removes color, shows intensity only.

Histogram
- Definition: Graph showing pixel intensity distribution.
- Why Use: To understand contrast and brightness.
- Effect: Helps analyze exposure.

Histogram Equalization
- Definition: Enhances contrast by spreading intensity values.
- Why Use: Improves visibility of dark/light areas.
- Effect: Makes features more visible.

Gaussian Blur
- Definition: Smoothens image by averaging pixel values.
- Why Use: To reduce noise or details.
- Effect: Makes the image softer.

Brightness Adjustment
- Definition: Changes intensity using: new = alpha*pixel + beta.
- Why Use: To lighten or darken image.
- Effect: Improves visibility.

Laplacian Filter

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- Definition: Edge detection using second derivative.
- Why Use: To detect and enhance edges.
- Effect: Highlights edges.

PANSHARPENING TECHNIQUES

HSV Transform
- Definition: RGB to HSV, replace Value with Panchromatic band.
- Why Use: To enhance spatial resolution with color.
- Effect: Sharper RGB image.

Brovey Transform
- Definition: Each RGB multiplied by (Pan / RGB sum).
- Why Use: Enhances contrast and sharpness.
- Effect: Sharper image with contrast.

RADIOMETRIC CORRECTION

Digital Number (DN)
- Definition: Raw pixel value in satellite images.
- Why Use: Input for radiance/reflectance.
- Effect: Doesn't show real energy.

TOA Radiance
- Definition: Light energy at the sensor.
- Why Use: Converts DN to energy.
- Effect: Used in brightness analysis.

TOA Reflectance
- Definition: Fraction of light reflected by surface.
- Why Use: For comparison across images.
- Effect: Shows surface properties.

Sun Elevation
- Definition: Angle of sun above horizon.
- Why Use: Used for reflectance correction.
- Effect: Affects brightness.

Metadata (MTL)
- Definition: File with image parameters.
- Why Use: Needed for reflectance/radiance.
- Effect: Contains gain, offset, etc.

CLASSIFICATION & CLUSTERING

Unsupervised Classification
- Definition: Groups similar pixels into classes.
- Why Use: Automated land cover segmentation.
- Effect: Color-coded land cover map.

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K-Means Clustering
- Definition: Groups pixels based on similarity.
- Why Use: For land classification.
- Effect: Creates cluster map.

RandomVisualizer
- Definition: Assigns colors to classes.
- Why Use: To see clusters clearly.
- Effect: Visual separation of classes.

Reclassification (remap)
- Definition: Converts class labels.
- Why Use: To manage labels better.
- Effect: Standardized class values.

PRINCIPAL COMPONENT ANALYSIS (PCA)

Mean Centering
- Definition: Subtracting mean from each band.
- Why Use: Standardizes data for PCA.
- Effect: Centers data around zero.

Covariance Matrix
- Definition: Shows band correlation.
- Why Use: Used in PCA.
- Effect: Finds patterns between bands.

Eigenvectors/values
- Definition: Directions and importance of variation.
- Why Use: Used for PCA transformation.
- Effect: Creates principal components.

Principal Components
- Definition: New uncorrelated bands from original.
- Why Use: Reduces dimensionality.
- Effect: Highlights key patterns.

GEOSPATIAL CONCEPTS (GEE)

ee.Image
- Definition: Single image in Earth Engine.
- Why Use: Basic analysis unit.
- Effect: Band manipulation, filtering.

ee.ImageCollection
- Definition: Group of images.
- Why Use: Used for filtering time, cloud.
- Effect: Time-series analysis.

filterBounds()

Remote Sensing Experiments: Summary for Oral Exam

- Definition: Selects images over area.
- Why Use: Focuses analysis.
- Effect: Region-based filtering.

filterDate()
- Definition: Selects images by date.
- Why Use: For seasonal/time studies.
- Effect: Date-wise filtering.

sort("CLOUD_COVER")
- Definition: Sorts by least cloud image.
- Why Use: To avoid clouds.
- Effect: Clearer image.

scale
- Definition: Pixel size in meters.
- Why Use: Controls resolution.
- Effect: Affects detail level.

geometry / region
- Definition: Spatial area for analysis.
- Why Use: Defines focus area.
- Effect: Limits analysis zone.

buffer()
- Definition: Expands a point to area.
- Why Use: Neighborhood analysis.
- Effect: Circular area region.

LIBRARIES & FUNCTIONS

OpenCV
- Definition: Python image processing library.
- Why Use: Histogram, enhancement, etc.
- Effect: Basic image operations.

NumPy
- Definition: Array operations library.
- Why Use: Math with image pixels.
- Effect: Data processing.

Matplotlib
- Definition: Visualization library.
- Why Use: Plot images, histograms.
- Effect: Shows results.

Rasterio
- Definition: Handles raster data.
- Why Use: Reads/Writes TIF files.
- Effect: Used in export.

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Earth Engine (ee)
- Definition: Cloud-based analysis tool.
- Why Use: Filtering, clustering, etc.
- Effect: Geospatial processing.

Geemap
- Definition: GEE + interactive maps.
- Why Use: Visualize Earth Engine outputs.
- Effect: Displays results.