# Optimizing Accuracy: A New Method to Automate Post-Processing of Mixture-Tuned Matched Filtering Remote Sensing Classification Results

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## BACKGROUND

**Goal:** Determine location and abundance of leafy spurge (*euphorbia esula*), a noxious and invasive plant species that replaces forgeable grass in the American west.

**Study Site:** 95km$^2$ Ucross Ranch in northeast Wyoming.
**Input Data:** 242-band hyperspectral imagery from the EO-1 Hyperion Sensor.
**Endmember:** Field, Lab, and Image collected spectral signatures of leafy spurge.
**Classification:** Mixture-Tuned Matched Filtering

**Classification Outputs**

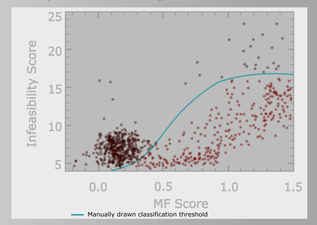
- Matched-Filtering (**MF**) image with continuous 0-1 scale, 1 being the best match to and indicating high density of the endmember .
- Mixture-Tuned (**Infeasibility**) image with 0-indefinite scale, with likelihood of a false positive increasing as number increases.

## PROBLEM

A threshold to determine acceptable classification scores must be selected for both the MF and Infeasibility image outputs before they are then combined to get the final classified image.

But:

- There is no proven or automated method to determine these thresholds.
- Abundance estimates of the MTMF classification are often reduced to presence/absence given the difficulty of defining appropriate thresholds.




Common practice is to pick an MF threshold above the background distribution and use a 2-D scatterplot to determine the relationship between the infeasibility score and the MF threshold as the MF score increases.

## METHODS

An R script was written to automate the process of choosing the threshold values for MF and Infeasibility scores to maximize map accuracy.

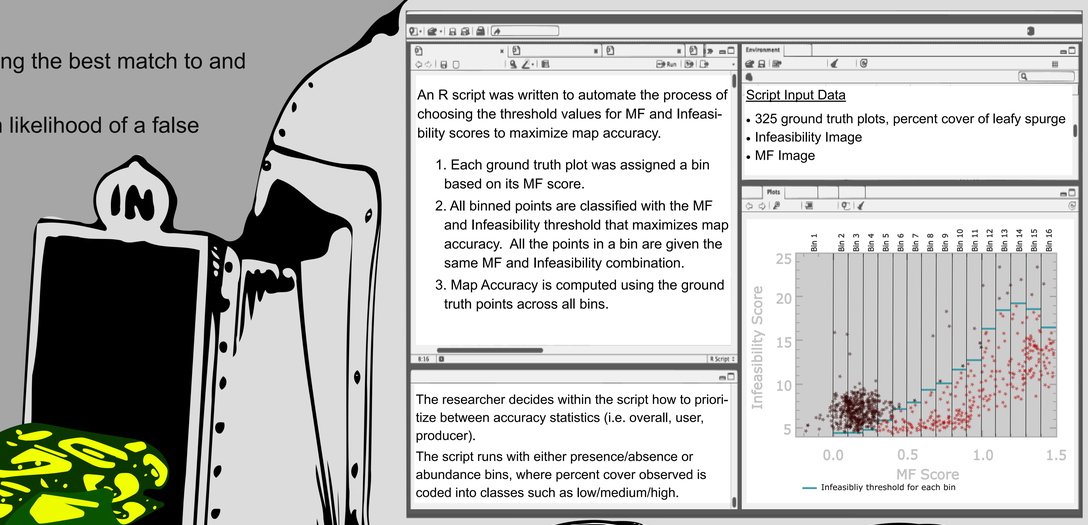
1. Each ground truth plot was assigned a bin based on its MF score.
2. All binned points are classified with the MF and Infeasibility threshold that maximizes map accuracy. All the points in a bin are given the same MF and Infeasibility combination.
3. Map Accuracy is computed using the ground truth points across all bins.

Script Input Data

- 325 ground truth plots, percent cover of leafy spurge
- Infeasibility Image
- MF Image

The researcher decides within the script how to prioritize between accuracy statistics (i.e. overall, user, producer).

The script runs with either presence/absence or abundance bins, where percent cover observed is coded into classes such as low/medium/high.




MF Score 0—Worst Match

MF Score 1—Best Match

Infeasibility 0—Accurate

Infeasibility High—False Positive

## RESULTS


**Overall Accuracy:** 91.69%
**Producer's Accuracy:** 59.09%
**User's Accuracy:** 74.29%


**Overall Accuracy:** 77.54%
**Av. Producer's Accuracy:** 55.06%
**Av. User's Accuracy:** 67.27%

References:

Mundt, J. 2007. Partial Unmixing of Hyperspectral Imagery: Theory and Methods. ASPRS Annual Conference.

Glenn, N., et. Al. 2005. Hyperspectral data processing for repeat detection of small infestations of leafy spurge. Remote Sensing of the Environment . V 95: pp. 399-412.

Williams and Hunt. 2002. Estimation of leafy spurge cover from hyperspectral imagery using mixture tuned matched filtering. Remote Sensing of Environment. V 82: pp 446-456.