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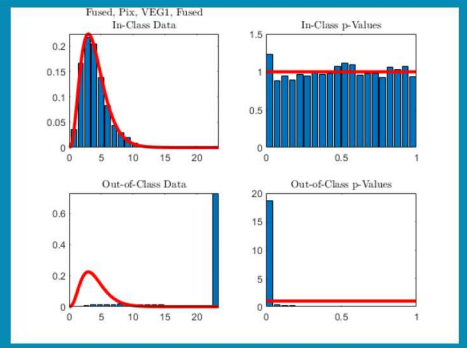
Optical and Polarimetric SAR Data Fusion Terrain Classification using Probabilistic Feature Fusion



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Hypothesis

Deciding on an imaging modality for terrain classification can be a challenging problem.

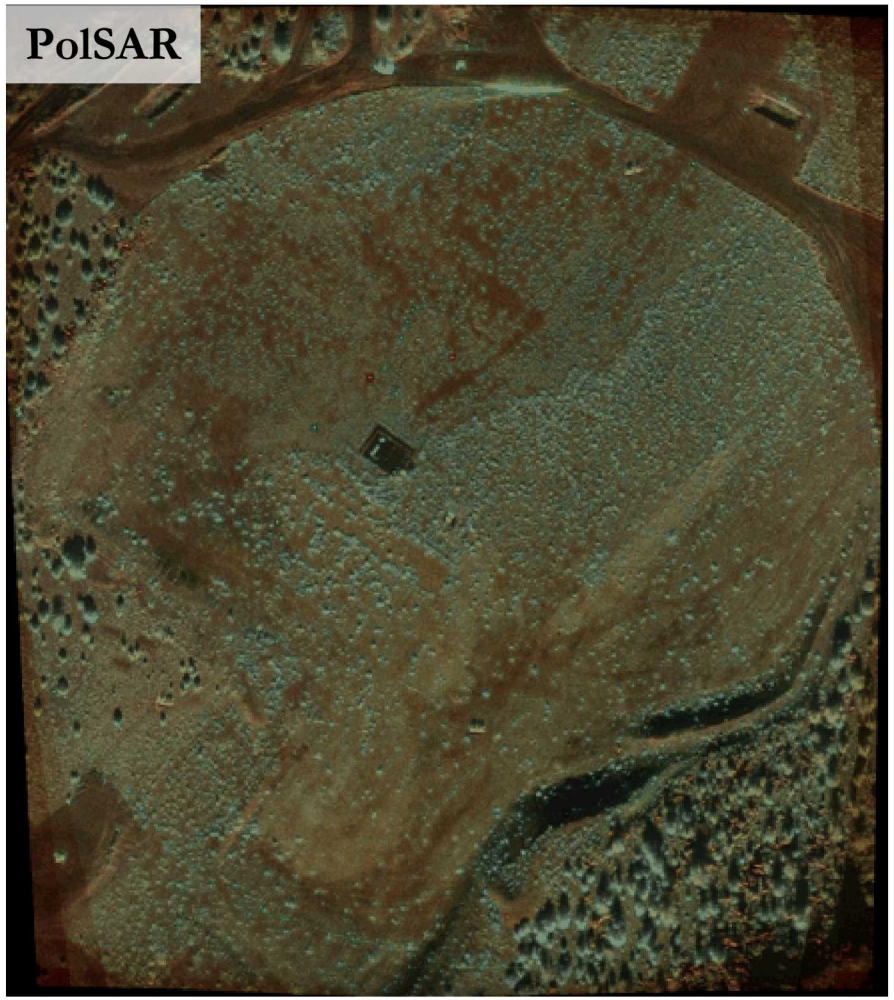
Is it possible to leverage the abilities of *multiple* sensing modalities to create more effective terrain classifiers?

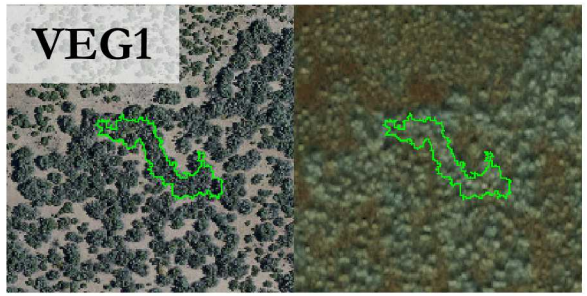
If so, then the challenge becomes determining how to combine the information in a meaningful and useful way.

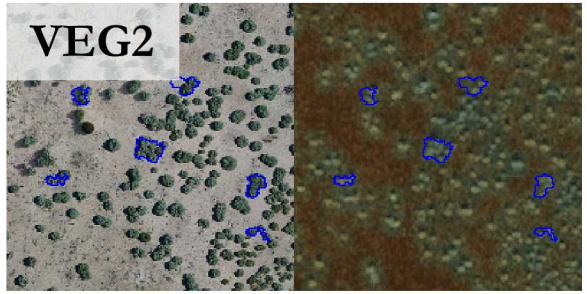
We introduce a fusion framework for effectively combining data from optical and polarimetric SAR sensing modalities.

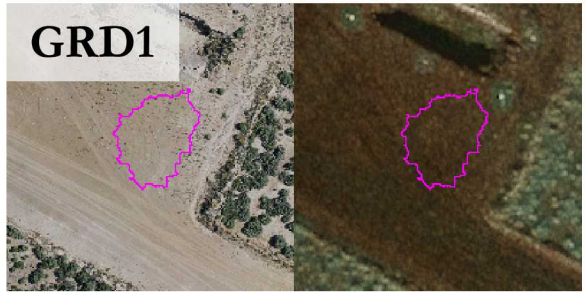
We demonstrate the fusion framework for two vegetation classes and two ground classes and show that fusing data from both imaging modalities has the potential to improve terrain classification from either modality, alone.

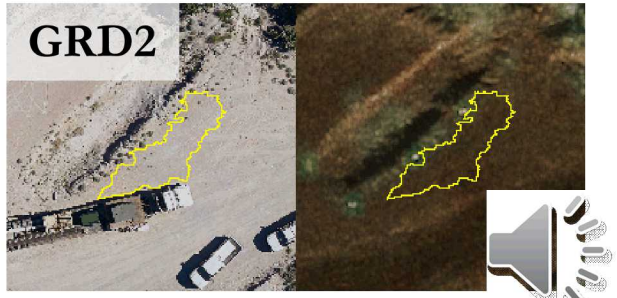
Optical and PolSAR Images, Feature Vector, and Terrain Classes









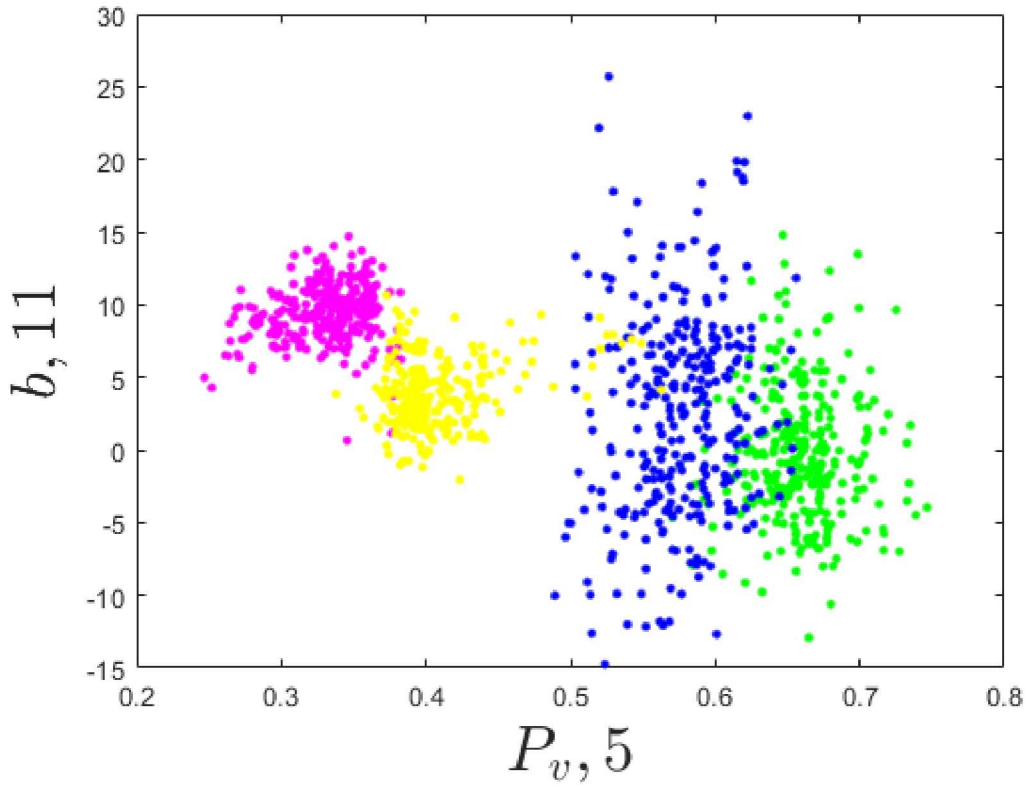


$$\mathbf{v}_{\text{Opt}} = [L \quad a \quad b]^T$$

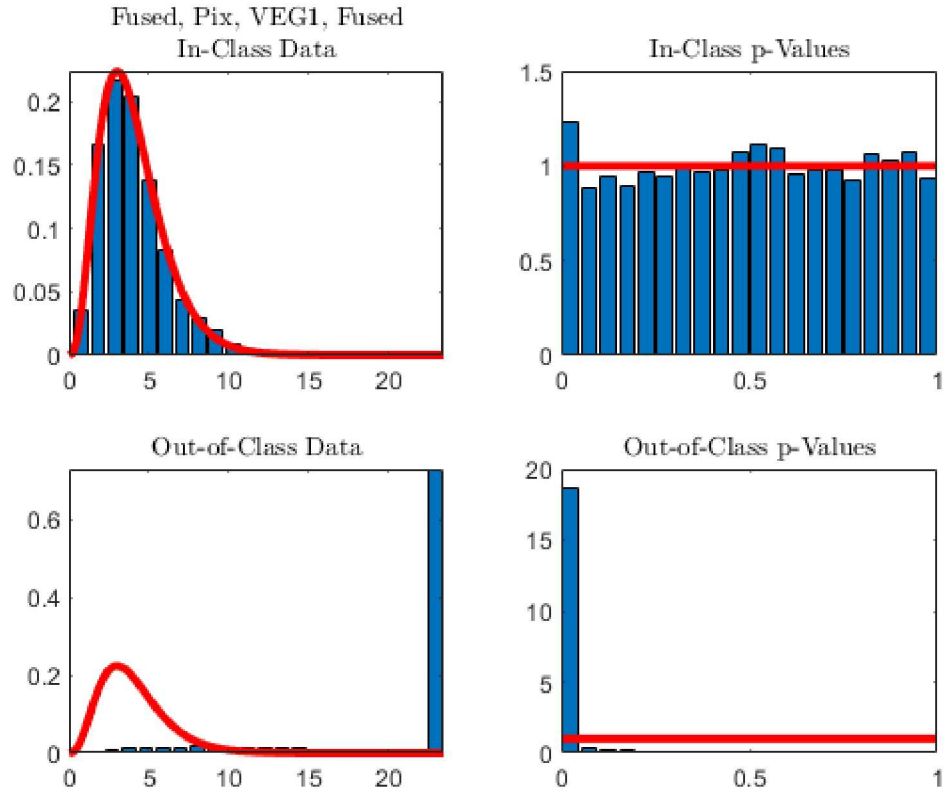
$$\mathbf{v}_{\text{SAR}} = [H \quad \alpha \quad P_s \quad P_d \quad P_v \quad P_c \quad Span \quad \gamma]^T$$

$$\mathbf{v} = \begin{bmatrix} \mathbf{v}_{\text{SAR}} \\ \mathbf{v}_{\text{Opt}} \end{bmatrix}$$

Feature Selection and Probabilistic Feature Fusion



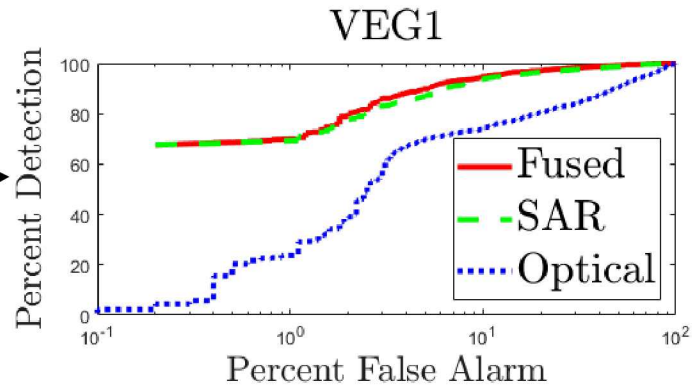
Generate metric and model with PFF

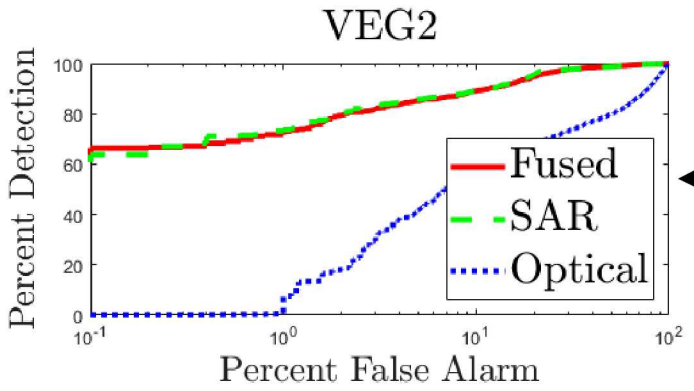


	VEG1	VEG2	GRD1	GRD2
Optical	L, a, b	L, a, b	L, a, b	L, a, b
PolSAR	H, P_d, P_v, P_c	H, P_d, P_v, P_c	H, P_v, γ	H, P_v, γ
Fused	H, P_d, P_v, P_c, b	H, P_d, P_v, P_c, L	H, P_v, γ, L, b	H, P_v, γ, L, b

Receiver Operating Characteristic (ROC) Curves and Conclusion

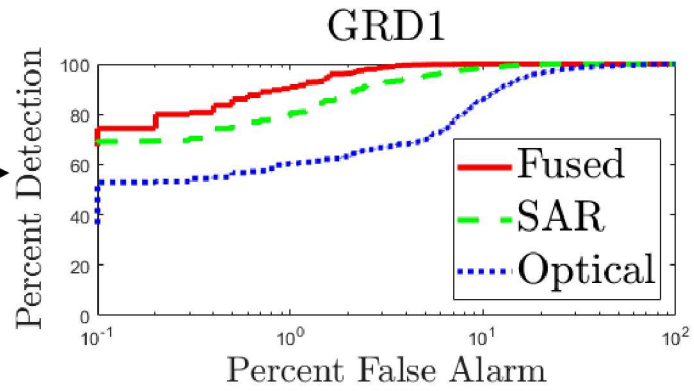
Fusing only gave an incremental increase in performance.

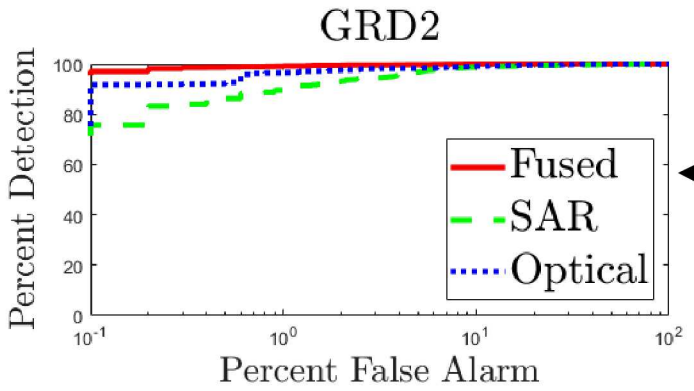




Overall, fusing did not improve performance.

Fusing gave a very nice increase in performance.





Fusing gave a small increase in performance.

Fusing terrain data from multiple remote sensing modalities can increase terrain classification performance.

Not every terrain class will benefit from fusing multiple remote sensing modalities: if one sensor does not discriminate a given class very well, then the performance from fusing may not increase and will likely match the performance of the more discriminating sensing modality.

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