NEURAL INFORMATION PROCESSING SYSTEMS

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Handwritten Text Recognition Lives in the High-Pixel Variance Subspace

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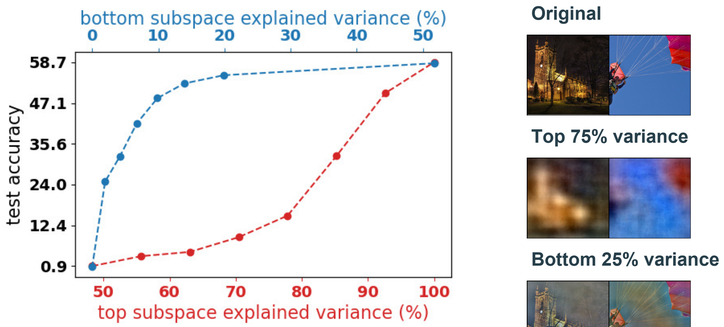
The useful pixel subspace depends on the recognition task

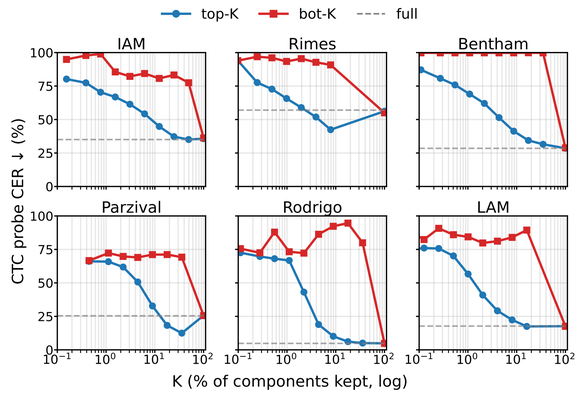
Handwriting recognition relies on high-variance pixel directions, reversing the pattern observed in natural images

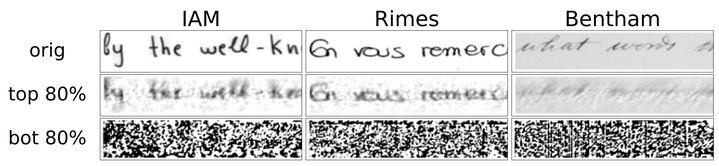
The recognition signal reverses

Natural-image classification (Balestriero & LeCun, 2024)



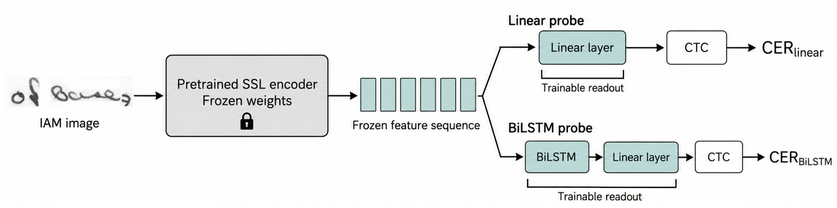
Handwritten text recognition





Why test handwriting separately?

- On natural images, pixel-grounded SSL has been argued to waste capacity on irrelevant detail (Balestriero & LeCun, 2024)
- For handwriting, that visual detail may carry the recognition signal
- We test whether preserving high pixel variance aids transcription

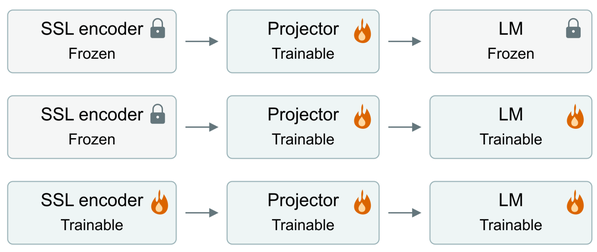


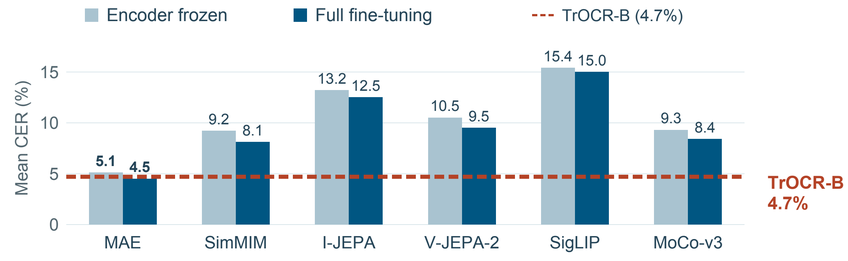
Recognition with a VLM

Stage 1
Alignment
Synthetic pairs

Stage 2
Encoder frozen
Real pairs

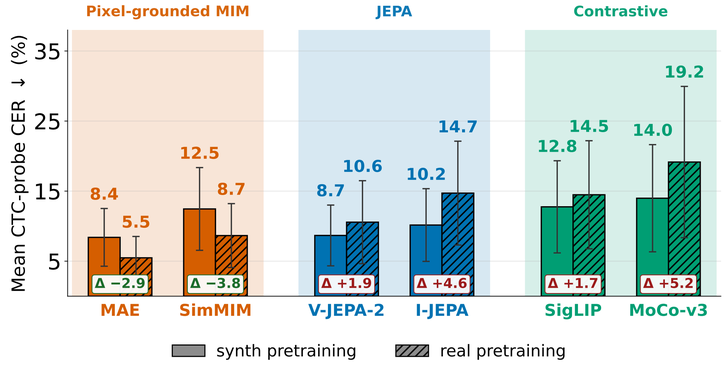
Stage 3
Full fine-tuning
Real pairs



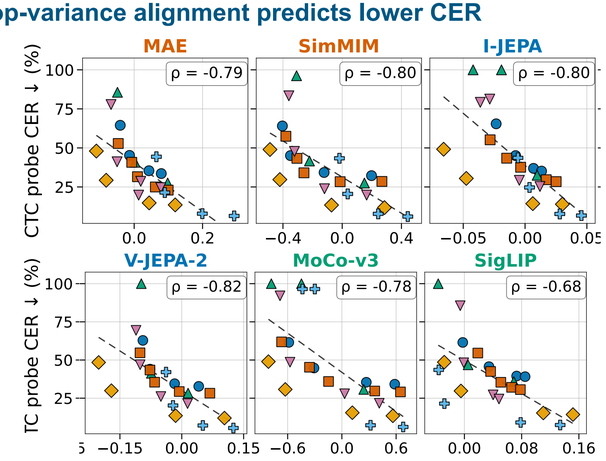


Recognition results

Frozen ViT-B + BiLSTM–CTC



Top-variance alignment predicts lower CER



R² gap: larger values indicate top-variance alignment

Conclusions

- HTR signal lies in high-variance pixel directions, reversing the natural-image pattern
- Stronger top-variance alignment predicts lower CER within every tested SSL method
- Full fine-tuning of the MAE-based VLM achieves results competitive with state-of-the-art HTR systems

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Reference

Balestriero, R., & LeCun, Y. (2024). How Learning by Reconstruction Produces Uninformative Features For Perception. ICML, PMLR 235, 2566–2585.