Explicit Metrics to Evaluate MENN Performance:

✅ 1. Reconstruction Quality Metrics:

Since MENN explicitly includes an autoencoder-like structure, these metrics help measure how accurately your model reconstructs input images.

Mean Squared Error (MSE) explicitly:

MSE=1N∑i=1N(xi−x^i)2\text{MSE} = \frac{1}{N}\sum_{i=1}^{N}(x_i - \hat{x}_i)^2MSE=N1i=1∑N(xi−x^i)2

(Lower values explicitly indicate better reconstructions.)

Peak Signal-to-Noise Ratio (PSNR) explicitly:

PSNR=10·log10(MAX2MSE)\text{PSNR} = 10 \cdot \log_{10}\left(\frac{MAX^2}{MSE}\right)PSNR=10·log10(MSEMAX2)

(Higher explicitly is better, indicates high-quality reconstructions.)

Structural Similarity Index (SSIM) explicitly: Measures explicitly perceived quality and similarity to human visual perception. (Range [0, 1], explicitly higher values are better.)

✅ 2. Explicit Clustering Metrics (for embeddings):

If you explicitly expect the embeddings to form meaningful clusters:

Silhouette Score explicitly:

Silhouette Score=b−amax(a,b)\text{Silhouette Score} = \frac{b - a}{\max(a, b)}Silhouette Score=max(a,b)b−a

Where:

aaa: Explicitly mean intra-cluster distance (within same class).

bbb: Explicitly mean nearest-cluster distance (closest other cluster).

Range: explicitly [-1, 1]; explicitly closer to 1 means clear, distinct clustering.

Davies–Bouldin Index (DBI) explicitly:

DBI=1C∑i=1Cmaxj≠i(si+sjdij)\text{DBI} = \frac{1}{C}\sum_{i=1}^{C}\max_{j\ne i}\left(\frac{s_i + s_j}{d_{ij}}\right)DBI=C1i=1∑Cj=imax(dijsi+sj)

Explicitly measures separation between clusters.

Lower explicitly is better (clearer clusters).

✅ 3. Explicit Classification Metrics (if you add supervision explicitly):

If MENN explicitly includes class prediction, consider these standard metrics:

Accuracy explicitly:

Accuracy=Correct PredictionsTotal Predictions\text{Accuracy} = \frac{\text{Correct Predictions}}{\text{Total Predictions}}
Accuracy=Total PredictionsCorrect Predictions

Precision, Recall, and F1 Score explicitly:

Precision=TPTP+FP,Recall=TPTP+FN,F1=2·Precision×RecallPrecision+Recall\text{Precision} = \frac{TP}{TP + FP}, \quad \text{Recall} = \frac{TP}{TP + FN}, \quad F1 = 2 \cdot \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}Precision=TP+FPTP,Recall=TP+FNTP
,F1=2·Precision+RecallPrecision×Recall

These explicitly measure quality of predicted labels (TP: true positive, FP: false positive, FN: false negative).

🔹 4. Embedding Quality Metrics explicitly (beyond clustering):

Intrinsic Dimensionality explicitly:

Measures explicitly how efficiently your embeddings use available dimensions. Lower intrinsic dimensionality explicitly indicates compact and meaningful embedding structures.

Entropy of Embeddings explicitly:

Your structured entropy metric explicitly (already used) indicates the richness of the latent representation.

Ideal explicitly is balanced entropy—not too low (trivial representation), not too high (no structure).

🔹 5. Computational Metrics explicitly:

Training Time explicitly:

Explicitly measure epochs required for convergence.

Lower explicitly indicates more efficient training.

Inference Time explicitly:

Explicitly measure the speed of predictions.

Lower explicitly is desirable for practical deployment.

Memory Efficiency explicitly:

Explicitly measure GPU/CPU RAM usage.

Lower explicitly allows scalability to larger datasets/models.

Explicit Recommendation: Which metrics to prioritize?

Explicit Goal	Metrics explicitly recommended
High-quality reconstructions	MSE, PSNR, SSIM explicitly
Clear embedding clusters explicitly	Silhouette Score, Davies–Bouldin Index
Predictive/Classification ability	Accuracy, Precision/Recall/F1 explicitly
Meaningful representation explicitly	Intrinsic Dimensionality, Entropy explicitly
Computational performance explicitly	Training time, Inference speed explicitly