ECE 599/692 – Deep Learning

Lecture 18 – How to Design a Network?

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How to find a research topic?

• According to Andrew Ng
  – Read a lot of papers
  – Re-implement them
  – Work hard

Hyperspectral Image (HSI) Super-Resolution (SR)

- Hyperspectral images (HSI): Low spatial but high spectral resolution
- Multispectral images (MSI): High spatial but low spectral resolution
The Traditional Formulation

\[ Y_h = S_h \Phi_h, \]
\[ X = S_m \Phi_h, \]
\[ Y_m = S_m \Phi_m. \]

The objective function:
\[ p(X|Y_h, Y_m) \]

The constraints on S:
- Sum-to-one and non-negative constraint.

The Deep-Learning Approach

Step 1: Unsupervised Learning

\[ Y_h = E_h(Y_m) \]
\[ D_h(Y_m) = W_h \Phi_h \]
\[ \Phi_h = \text{shared weights} \]

Step 2: Sum-to-one and Non-negativity on S

\[ S_j = \begin{cases} v_j & \text{for } j = 1 \\ v_j \prod_{k=2}^{J} (1 - v_k) & \text{for } j > 1 \end{cases} \]

Kumaraswamy:
\[ v_j \sim (1 - (1 - u^k)^{1/k}). \]
The Deep-Learning Approach
Step 3: Sparsity on S

\[ y_H(s) = \sum_{j=1}^{o<j} \left( \frac{|s_j|^p}{|y|^p} \right) \phi(s_j) \]

The Deep-Learning Approach
Step 4: The Angular Similarity Constraint

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Review: Our Objectives and Formulation