Streamable Neural Fields

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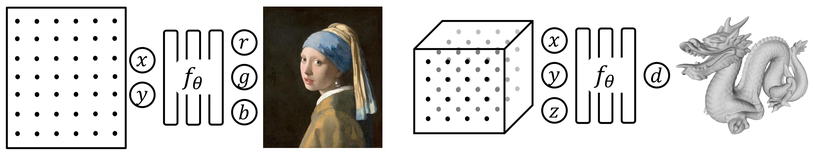
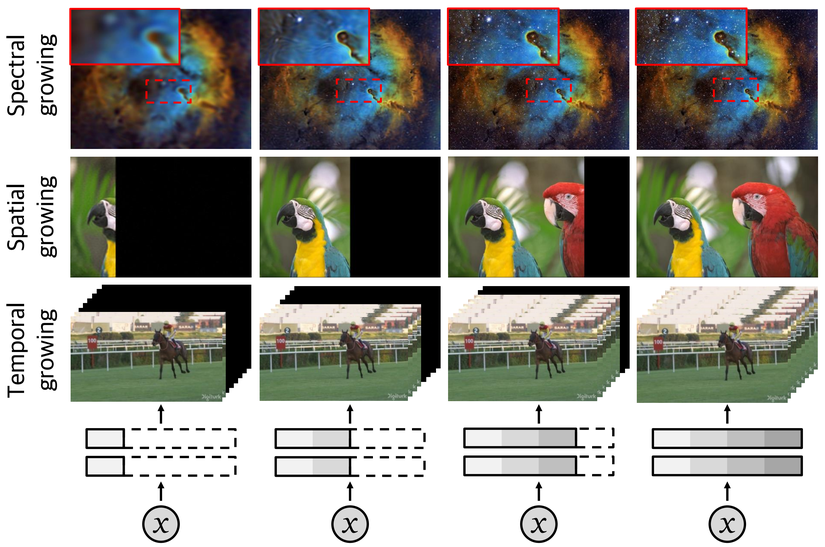
Neural Fields

- ✓ Encoding a signal into a coordinate-based neural network.
- ✓ Requires the entire network parameters for decoding.



Streamable Neural Fields (Ours)

Designed neural fields that can be decoupled into parts.



Progressive vs Slimmable Training

- ✓ Progressive [1]: grow the width after convergence of each sub-net.
- ✓ Slimmable [2]: accumulate the gradients of each sub-net. and update the parameters in each epoch.

Algorithm 1 Progressive training

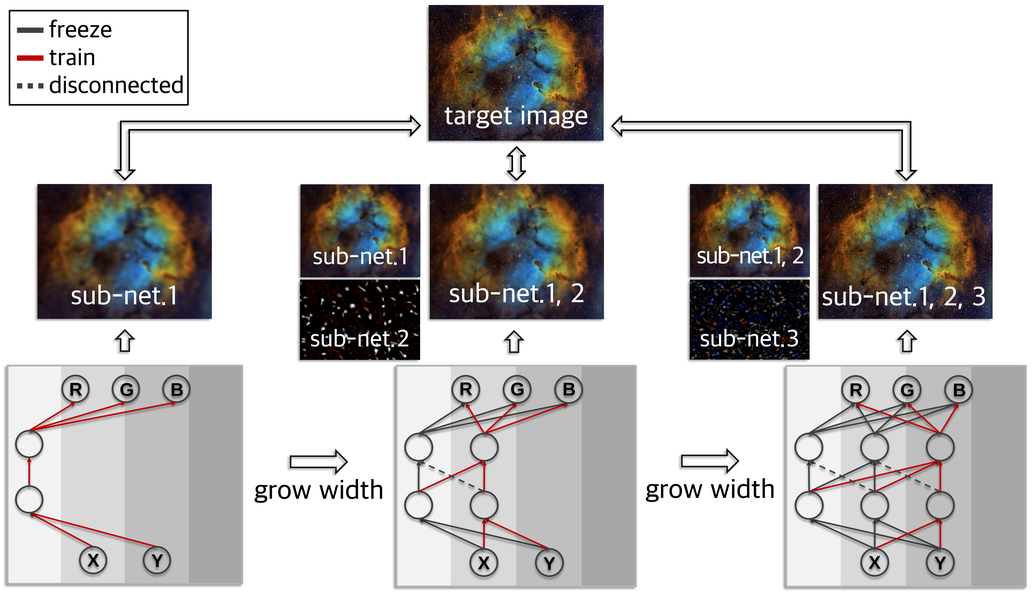
Require: Inputs x, targets y
$\theta = \{\}$
while not done **do**
  $\theta_{\text{new}} \leftarrow$ GrowNetwork()
  Initialize θ_{new}
  $\theta \leftarrow \theta \cup \{\theta_{\text{new}}\}$
  for epoch $= 0$ to n_{steps} **do**
    Predict signal values $\hat{y} = f_\theta(x)$
    Compute loss $\mathcal{L}(y, \hat{y})$
    Compute gradients $\nabla_{\theta_{\text{new}}}\mathcal{L}$
    Update θ_{new}
  end for
end while

Algorithm 2 Slimmable training

Require: Inputs x, targets y
Require: Parameters $\{\theta_{w_1}, \ldots, \theta_{w_K}\}$
for epoch $= 0$ to n_{steps} **do**
  $\theta = \{\}$
  for $i = 1$ to K **do**
    $\theta \leftarrow \theta \cup \{\theta_{w_i}\}$
    Predict signal values $\hat{y} = f_\theta(x)$
    Compute loss $\mathcal{L}(y, \hat{y})$
    Compute gradients $\nabla_\theta \mathcal{L}$
    Accumulate gradients
  end for
  Update $\theta_{w_i}, \forall i \in \{1, ..., K\}$
end for

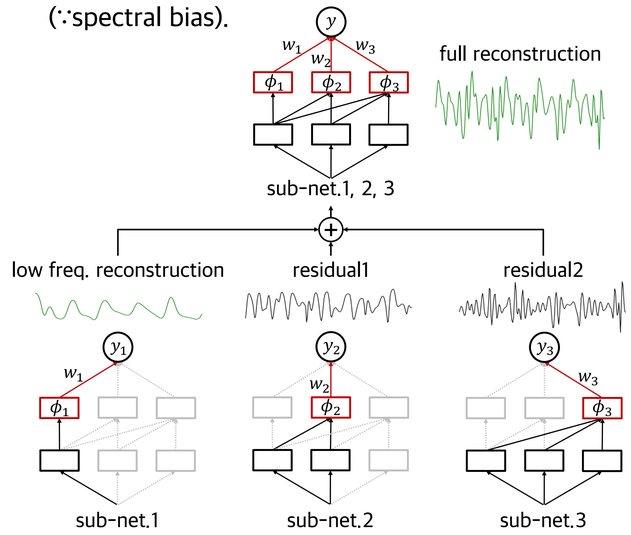
[1] Progressive Neural Networks, Rusu et al., arXiv 2016
[2] Slimmable Neural Networks, Yu et al., ICLR 2019

Network Architecture and Progressive Training

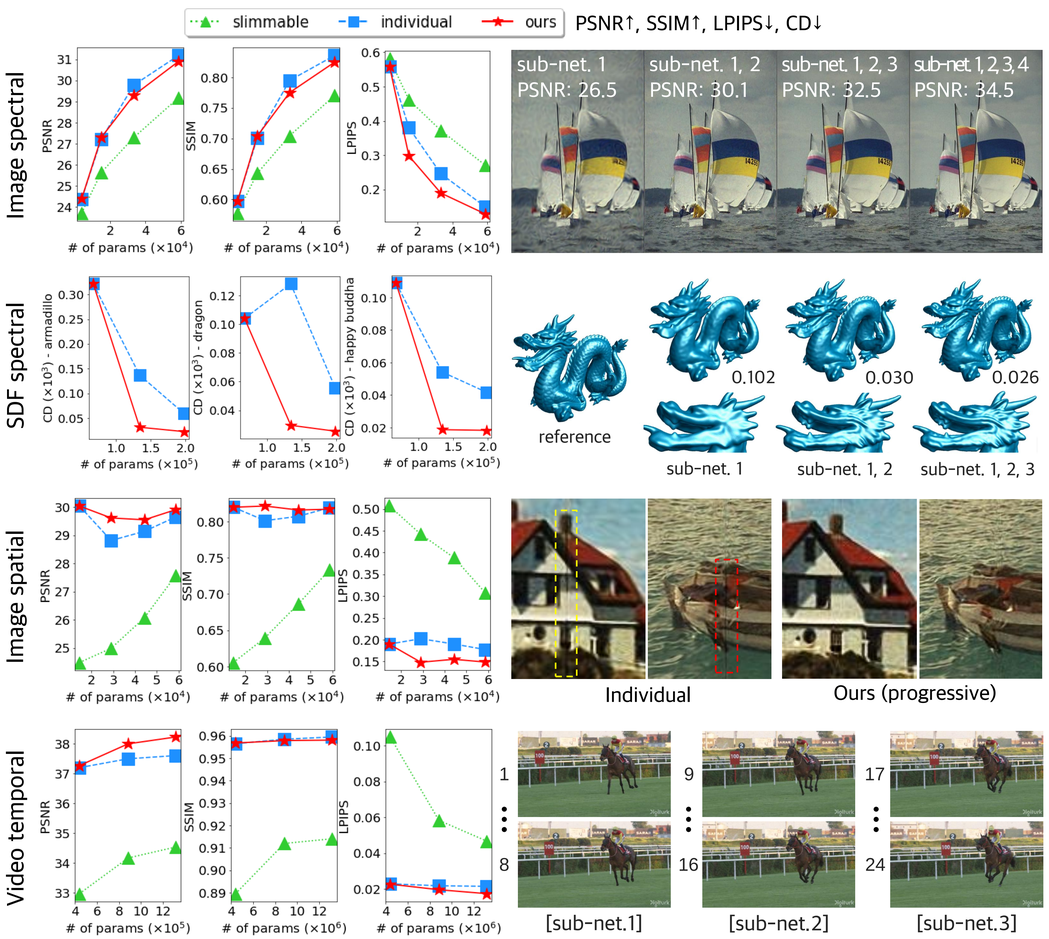


Learning Spectral Decomposition

- ✓ Each sub-net. learns the residual ($\because y = \sum_j w_j \phi_j$).
- ✓ Learns signals in increasing frequency orders ($\because$spectral bias).



Experimental Results



Training Dynamics

- ✓ Our method significantly stabilizes the training by smoothing the loss landscape.