Neural Architecture Search for Image Super-Resolution Using Densely Connected Search Space: DeCoNAS

Intelligent Signal Processing Lab, Seoul National University Joon young, Ahn



Contents

- Single image super-resolution(SISR)
- Neural architecture search(NAS)
- Proposed algorithm
- Experimental results

Single image super-resolution(SISR)

- Creates a clearer high-resolution image from a single low- resolution image
- Used as a pre-processing step of various tasks
- > medical image analysis, security image processing, etc.



Neural architecture search (NAS)

Neural Networks are hard to design

(operation types, layer numbers, information flows, etc.)

- There is no standard way to design Neural Network
- The goal of Neural architecture search is to train deep neural network that proposes optimal network for certain task



Proposed algorithm (DeCoNASNet)

- Construct DeCoNASNet search space from residual dense network (RDN) baseline
 - > consist of SFENet, DeCoNet, UPNet
 - > DeCoNet contains Densely Connected Block (DNB) and feature fusion
 - > use periodic shuffling layer to upsample low-resolution feature



Proposed algorithm (DeCoNASNet)

Constructed example of controller sequence and DeCoNASNet



Proposed algorithm (DeCoNASNet)

Training parameters of child network

> we use adam optimizer to minimize

 $\min_{\mathbf{w}} \mathbb{E}_{\mathbf{c} \sim \pi(\mathbf{c}; \boldsymbol{\theta})}[L(\mathbf{c}; \mathbf{w})]$

Training parameters of controller by REINFORCE algorithm

> we propose complexity-based penalty added to the reward signal in REINFORCE algorithm

> maximize expected reward calculated with complexity-based penalty and PSNR of validation dataset

Experimental results

Quantitative results for ×2 SR task to public benchmark datasets

Model	Params	Set 5	Set 14	B100	Uban100	Design time
Bicubic	-	33.66 / 0.9299	30.24 / 0.8688	29.56 / 0.8431	26.88 / 0.8403	
SRCNN [6]	57K	36.66 / 0.9542	32.45 / 0.9067	31.36 / 0.8879	29.50 / 0.8946	
VDSR [9]	665K	37.53 / 0.9587	33.03 / 0.9124	31.90 / 0.8960	30.76 / 0.9140	-
LapSRN [15]	813K	37.52 / 0.9591	33.08 / 0.9130	31.80 / 0.8950	30.41 / 0.9101	-
MemNet [12]	677K	37.78 / 0.9597	33.28 / 0.9142	32.08 / 0.8978	31.31 / 0.9195	
SelNet [17]	970K	37.89 / 0.9598	33.61 / 0.9160	32.08 / 0.8984	- / -	-
CARN [14]	1,582K	37.76 / 0.9590	33.52 / 0.9166	32.09 / 0.8978	31.92 / 0.9256	-
MoreMNAS-A [29]	1,039K	37.63 / 0.9584	33.23 / 0.9138	31.95 / 0.8961	31.24 / 0.9187	56 GPU days
FALSR-A [30]	1,021K	37.82 / 0.9595	33.55 / 0.9168	32.12 / 0.8987	31.93 / 0.9256	24 GPU days
DeCoNASNet (ours)	1,713K	37.96 / 0.9594	33.63 / 0.9175	32.15 / 0.8986	32.03 / 0.9265	12 GPU hours

Experimental results

Qualitative comparison of conventional methods and ours



Thank You!