Image Super-Resolution Using Deep Convolutional Networks

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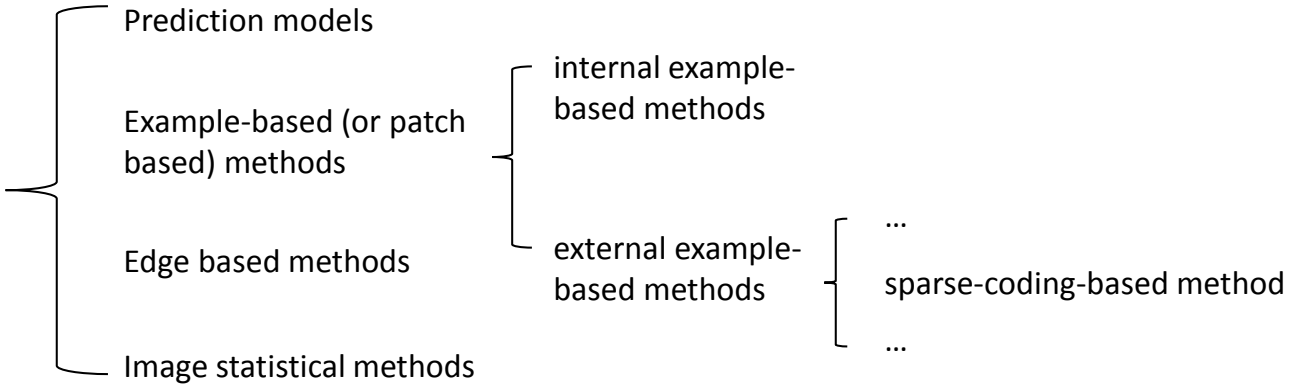
1. Introduction

◆ What's SR?

Single image super-resolution (SR):

aims at recovering a high-resolution image from a single low-resolution image.

◆ SR algorithms



2. Sparse-coding-based method (SC)

◆ Sparse-coding-based method (SC)

The example-based strategy is mostly adopted in the prior and recent state-of-the-art methods, and SC is one of the representative external example-based SR methods.

Four steps in solution pipeline of SC:

(1) Obtain the overlapping patches densely cropped from the input image and pre-process

(2) Encode the low-resolution patches

(3) Reconstruct the high-resolution patches by the sparse coefficients

(4) Produce the final output using the overlapping reconstructed patches

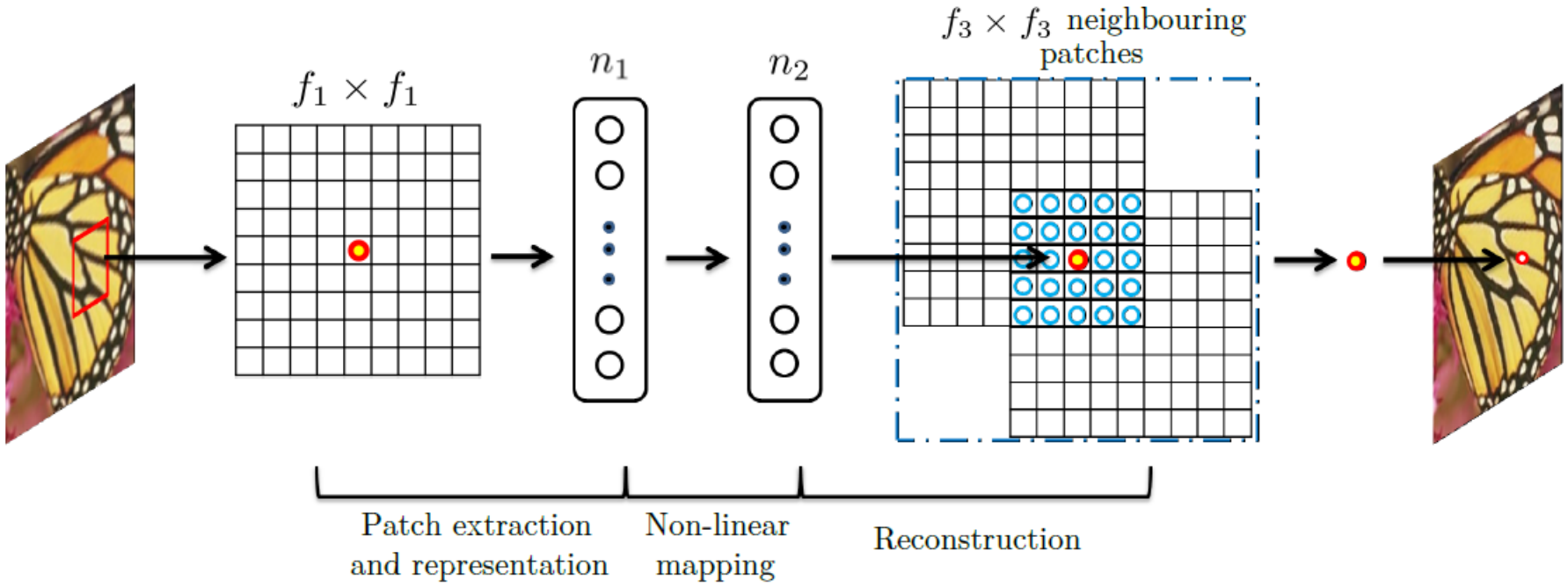


Fig. 1 An illustration of sparse-coding-based methods in the view of a convolutional neural network

Motivated by the fact that the pipeline of SC is equivalent to a deep convolutional neural network, a Super-Resolution Convolutional Neural Network is proposed.

3. Super-Resolution Convolutional Neural Network (SRCNN)

- SRCNN differs fundamentally from existing external example-based approaches, and directly learns an end-to-end mapping between low- and high-resolution images.

✓ Four advantages of SRCNN:

(1) Simplicity structure and superior accuracy output

(2) Has moderate numbers of filters and layers, achieves faster speed as fully feed-forward

(3) Restoration quality (output) of the network can be further improved

(4) can cope with three channels of color images simultaneously

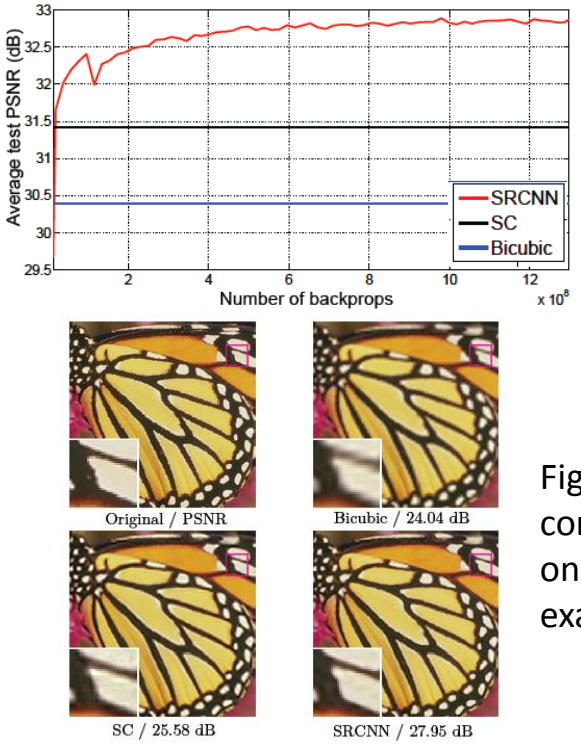


Fig. 2 a comparison on an example

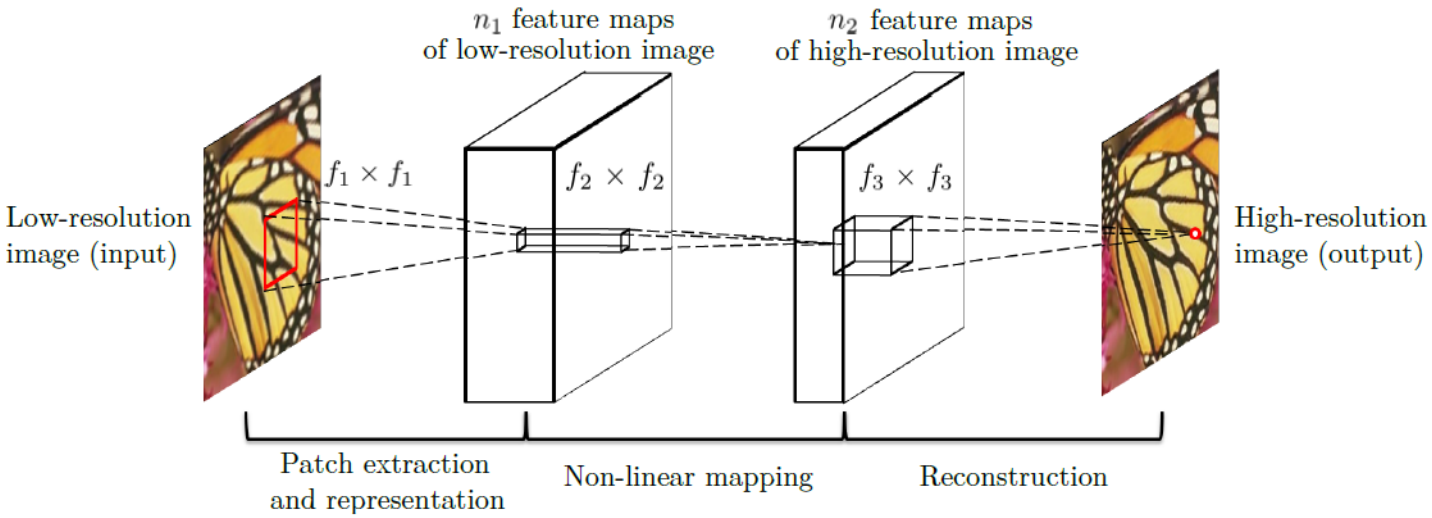


Fig. 3 An overview of the network of SRCNN

- Model and performance trade-offs

(1) Filter number

It is clear that superior performance could be achieved by increasing the width. However, if a fast restoration speed is desired, a small network width is preferred.

(2) Filter size

Using a larger filter size could significantly improve the performance. However the deployment speed will also decrease with a larger filter size.

(3) Number of layers

it is not “the deeper the better” in this deep model for super-resolution.