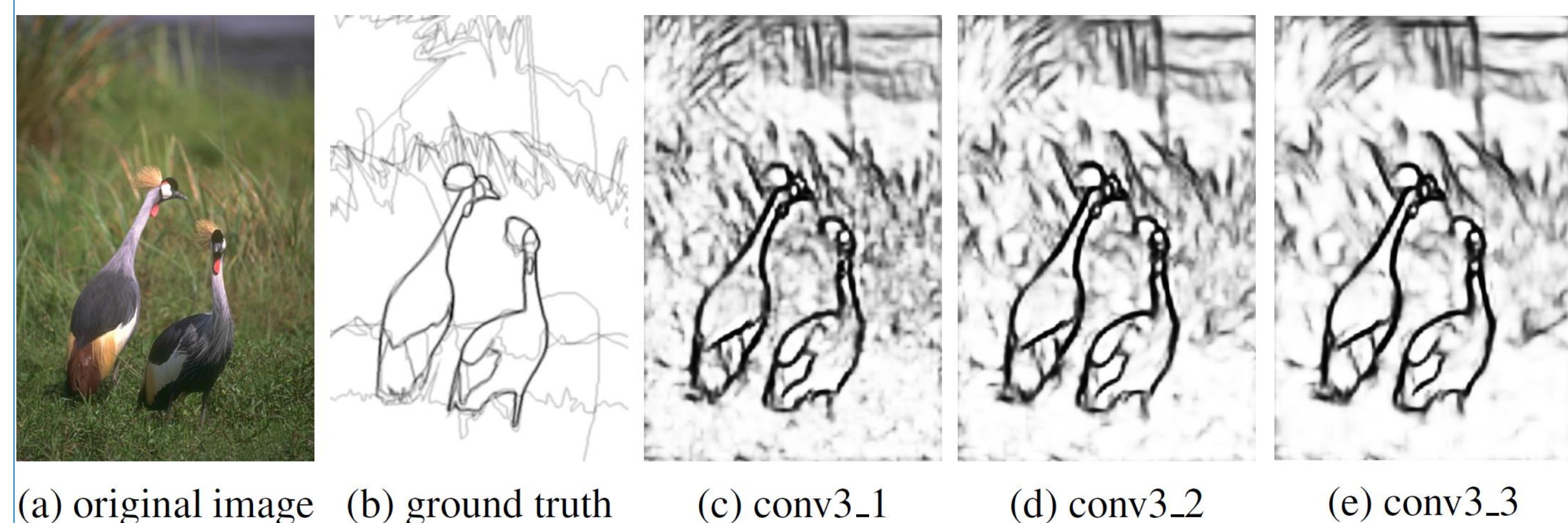


## Introduction

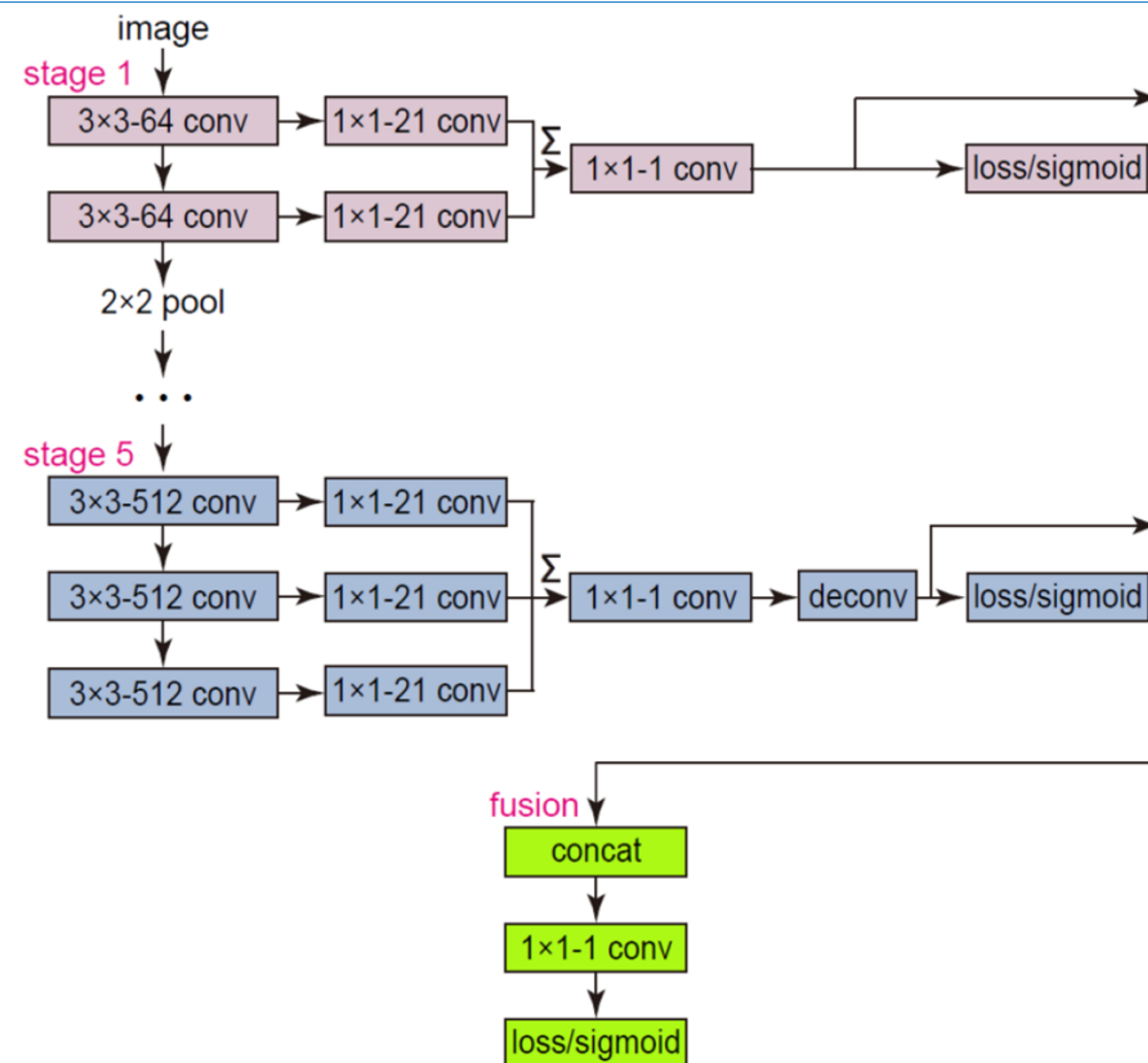
In this paper, we propose an accurate edge detector using richer convolutional features (RCF). Since objects in natural images possess various scales and aspect ratios, learning the rich hierarchical representations is very critical for edge detection. CNNs have been proved to be effective for this task. In addition, the convolutional features in CNNs gradually become coarser with the increase of the receptive fields. According to these observations, we attempt to adopt richer convolutional features in such a challenging vision task. The proposed network fully exploits multiscale and multilevel information of objects to perform the image-to-image prediction by combining all the meaningful convolutional features in a holistic manner. Using VGG16 network, we achieve state-of-the-art performance on several available datasets. When evaluating on the well-known BSDS500 benchmark, we achieve ODS F-measure of **0.811** while retaining a fast speed (**8 FPS**). Besides, our fast version of RCF achieves ODS F-measure of **0.806** with **30 FPS**.

## Motivation

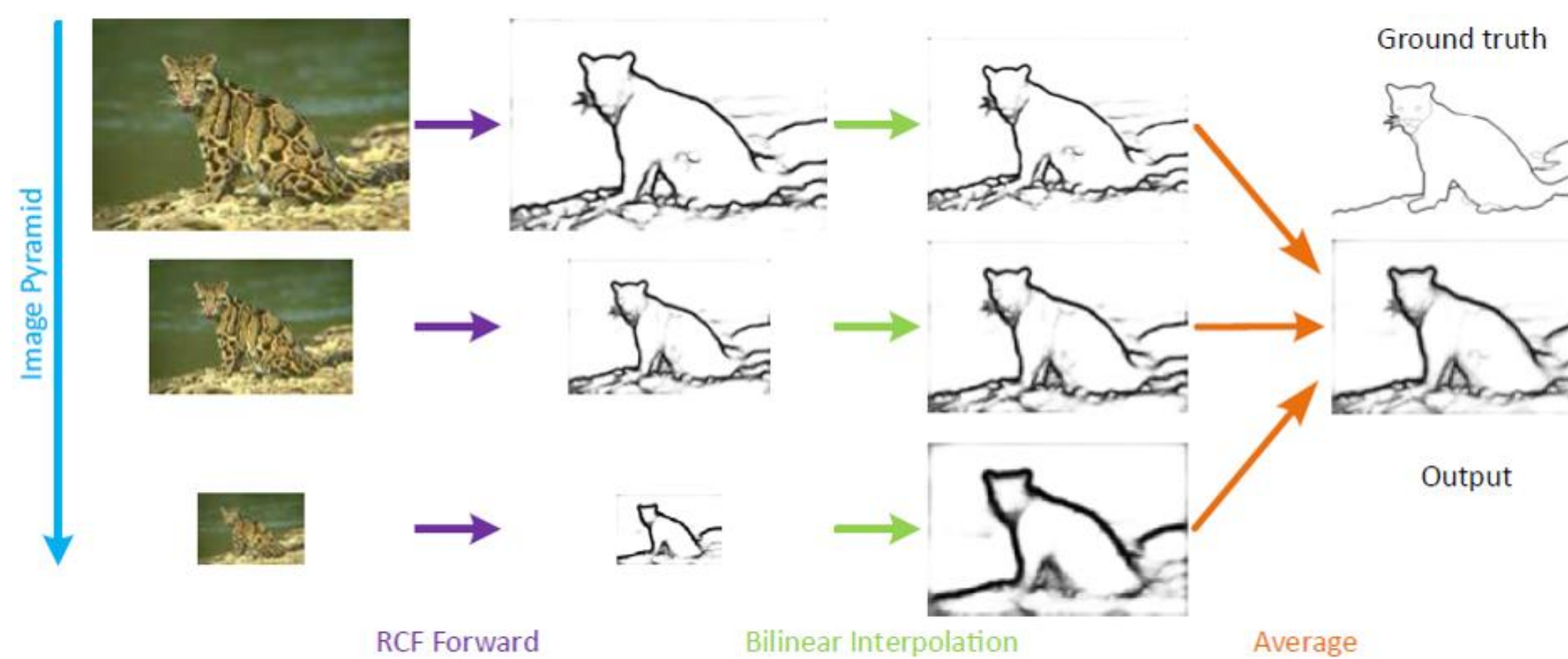


We build a simple network based on VGG16 to produce side outputs of conv3\_1, conv3\_2 and conv3\_3. One can clearly see that convolutional features become coarser gradually, and the intermediate layers conv3\_1 and conv3\_2 contain lots of useful fine details that do not appear in conv3\_3.

## Network Architecture

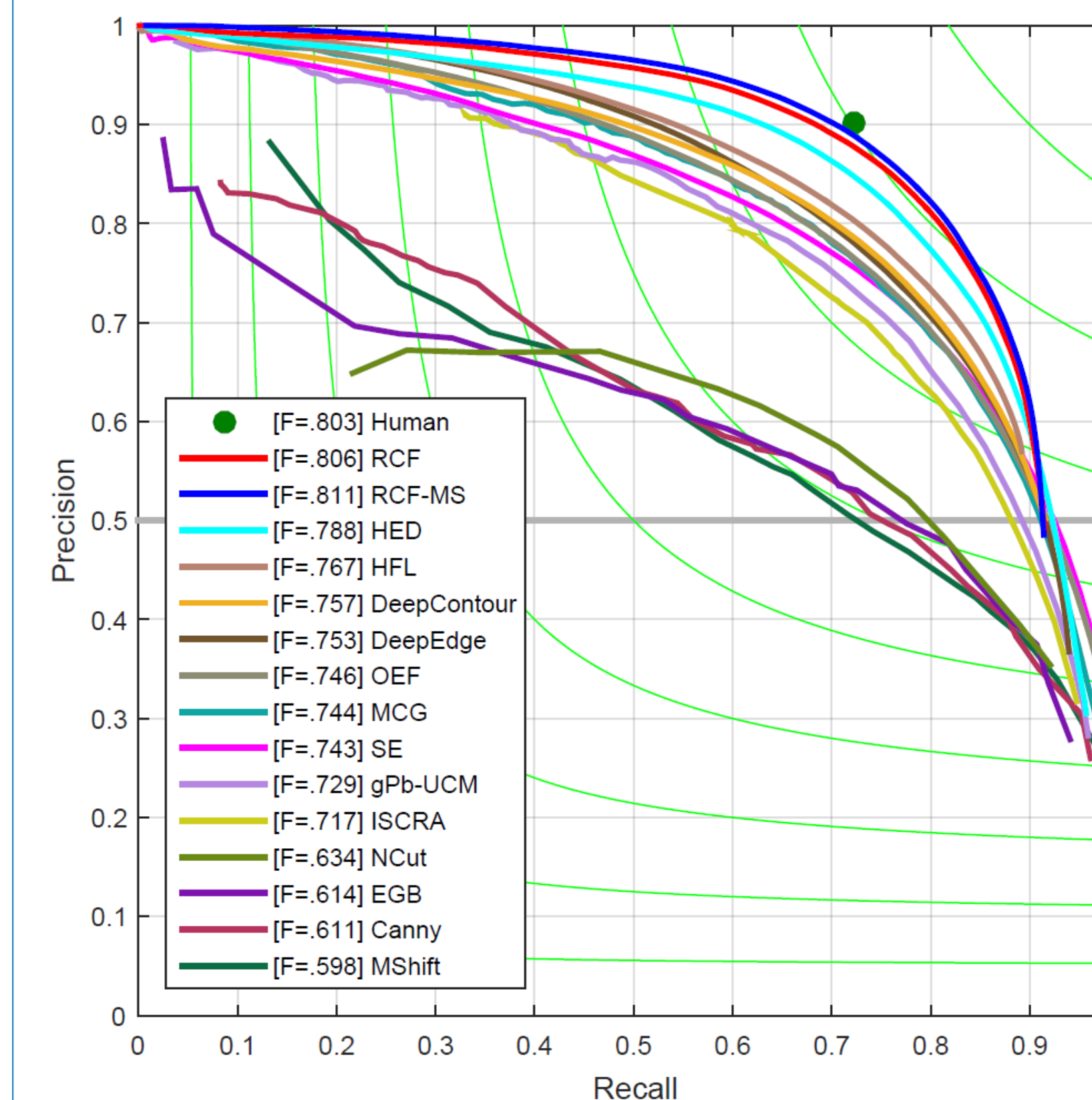


## Multiscale



The original image is resized to construct an image pyramid. And these multiscale images are input to RCF network separately for a forward pass. A simple average of these edge maps will output high-quality edges.

## Evaluation on BSDS500 Dataset



Method	ODS	OIS	FPS
Canny [6]	.611	.676	28
EGB [16]	.614	.658	10
MShift [10]	.598	.645	1/5
gPb-UCM [2]	.729	.755	1/240
Sketch Tokens [36]	.727	.746	1
MCG [3]	.744	.777	1/18
SE [14]	.743	.763	2.5
OEF [24]	.746	.770	2/3
DeepContour [47]	.757	.776	1/30 <sup>†</sup>
DeepEdge [4]	.753	.772	1/1000 <sup>†</sup>
HFL [5]	.767	.788	5/6 <sup>†</sup>
N <sup>4</sup> -Fields [19]	.753	.769	1/6 <sup>†</sup>
HED [58]	.788	.808	30 <sup>†</sup>
RDS [37]	.792	.810	30 <sup>†</sup>
CEDN [59]	.788	.804	10 <sup>†</sup>
MIL+G-DSN+MS+NCuts [29]	.813	.831	1
RCF	.806	.823	30 <sup>†</sup>
RCF-MS	.811	.830	8 <sup>†</sup>

