Deep Joint Rain Detection and Removal from a Single Image

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Introduction

● Motivation

● Challenges

- The intrinsic overlapping between rain streaks and texture.
- Complex degradations, *e.g.* heavy rain and mist.
- A limited receptive field.

● Contributions

- *Region-dependent rain models*
  Rain-streak binary mask
  Diversified streaks & accumulation
- *Joint rain detection and removal*
- *Contextualized dilated network*
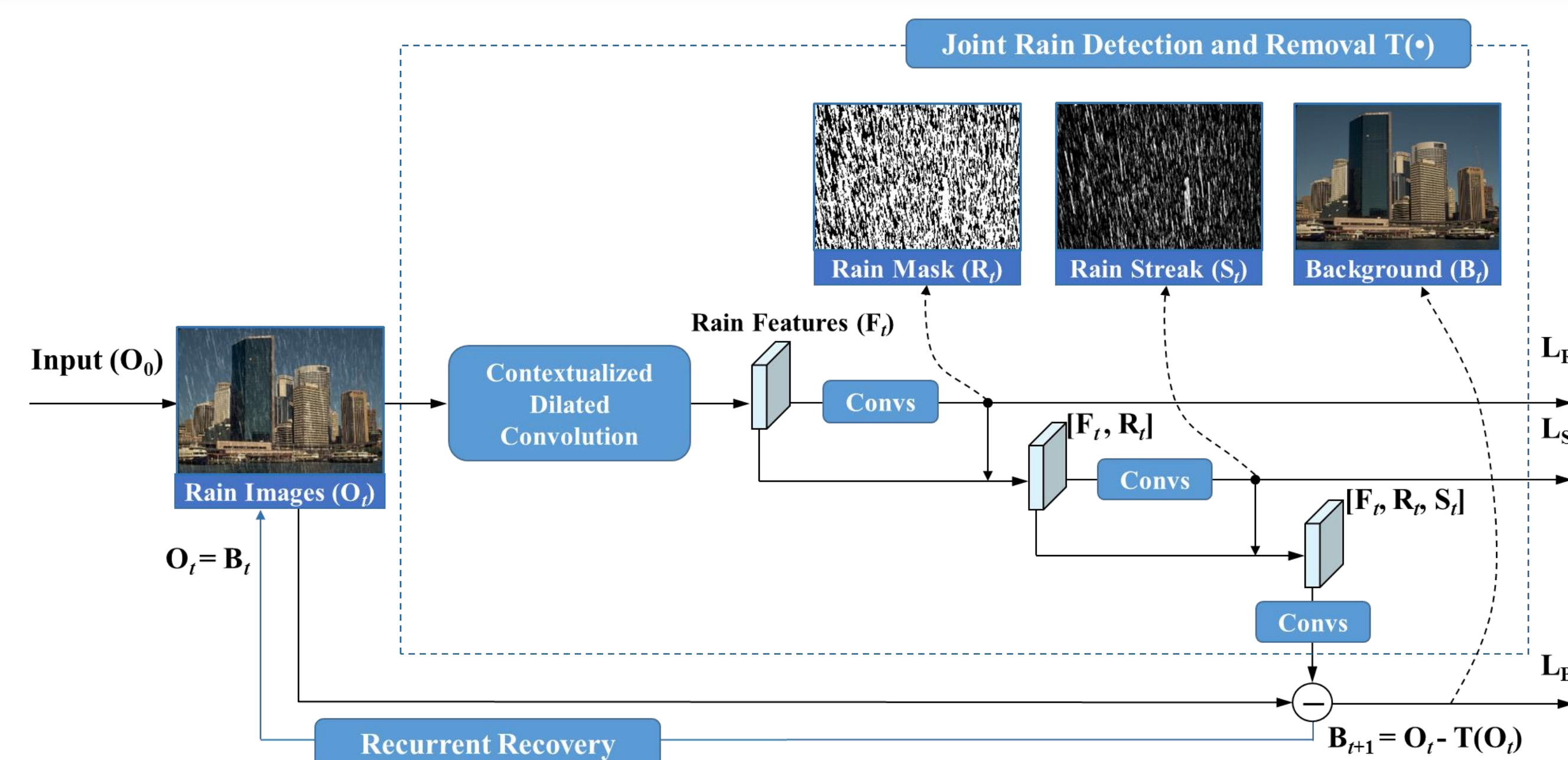
Rain Image Formation

● Region dependent

- Rain localization.
- Allowing a new rain removal pipeline to detect rain regions first, and then to operate differently.

● Mist and heavy rains

$$\mathbf{O} = \alpha \left(\mathbf{B} + \sum_{t=1}^{s} \tilde{\mathbf{S}}_t \mathbf{R} \right) + (1-\alpha)\mathbf{A}$$

Recurrent Joint Rain Detection and Removal

● Rain detection, estimation and removal

$$\mathbf{F} \to \mathbf{R}, \quad \left[\mathbf{F},\mathbf{R}\right] \to \mathbf{S}, \quad \left[\mathbf{F},\mathbf{R},\hat{\mathbf{S}},\mathbf{O}-\mathbf{R}\hat{\mathbf{S}}\right] \to \mathbf{B}$$

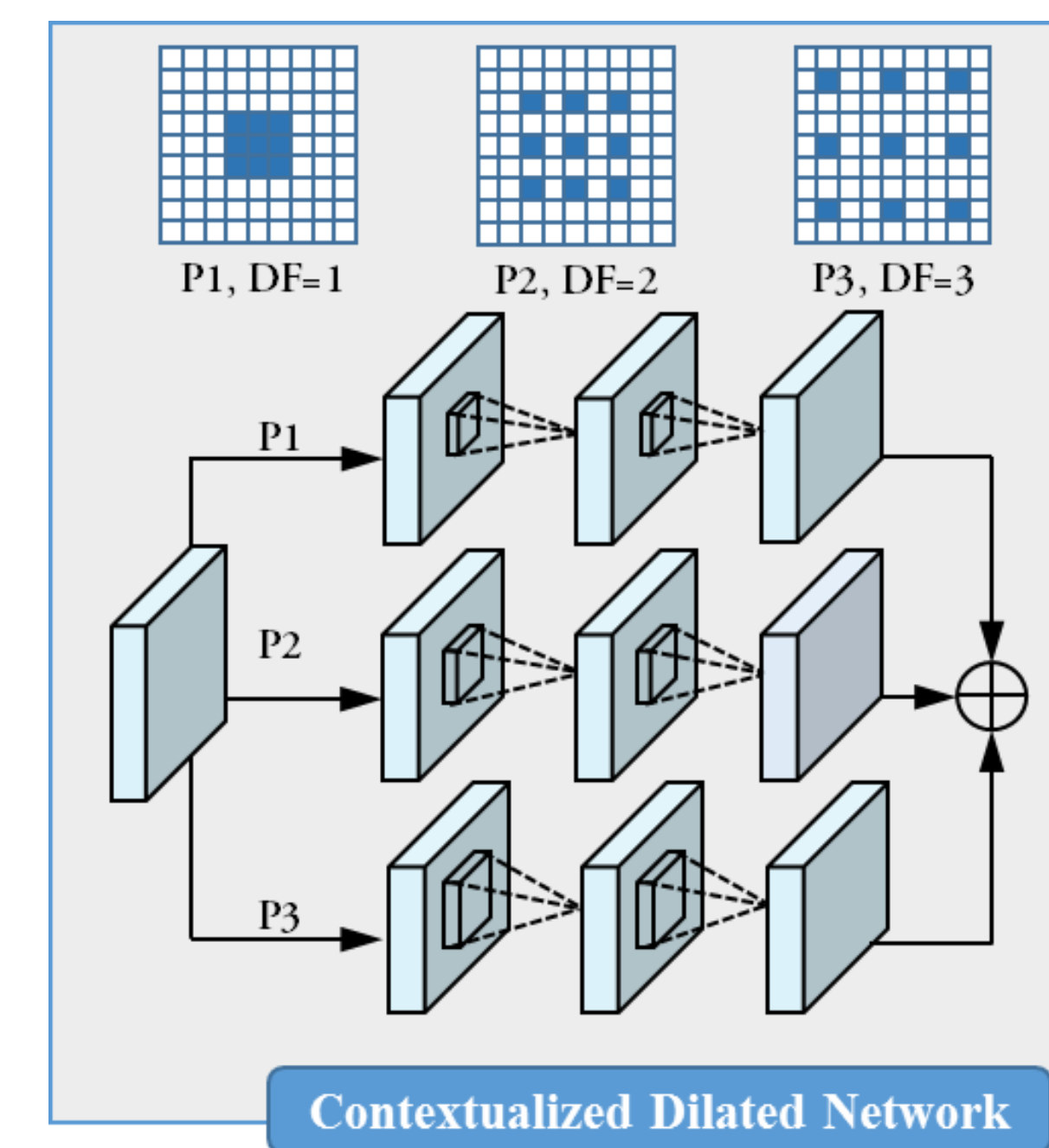## Contextualized Dilated Network

● Motivation
- A larger receptive field.
- More context information.

● ResNet
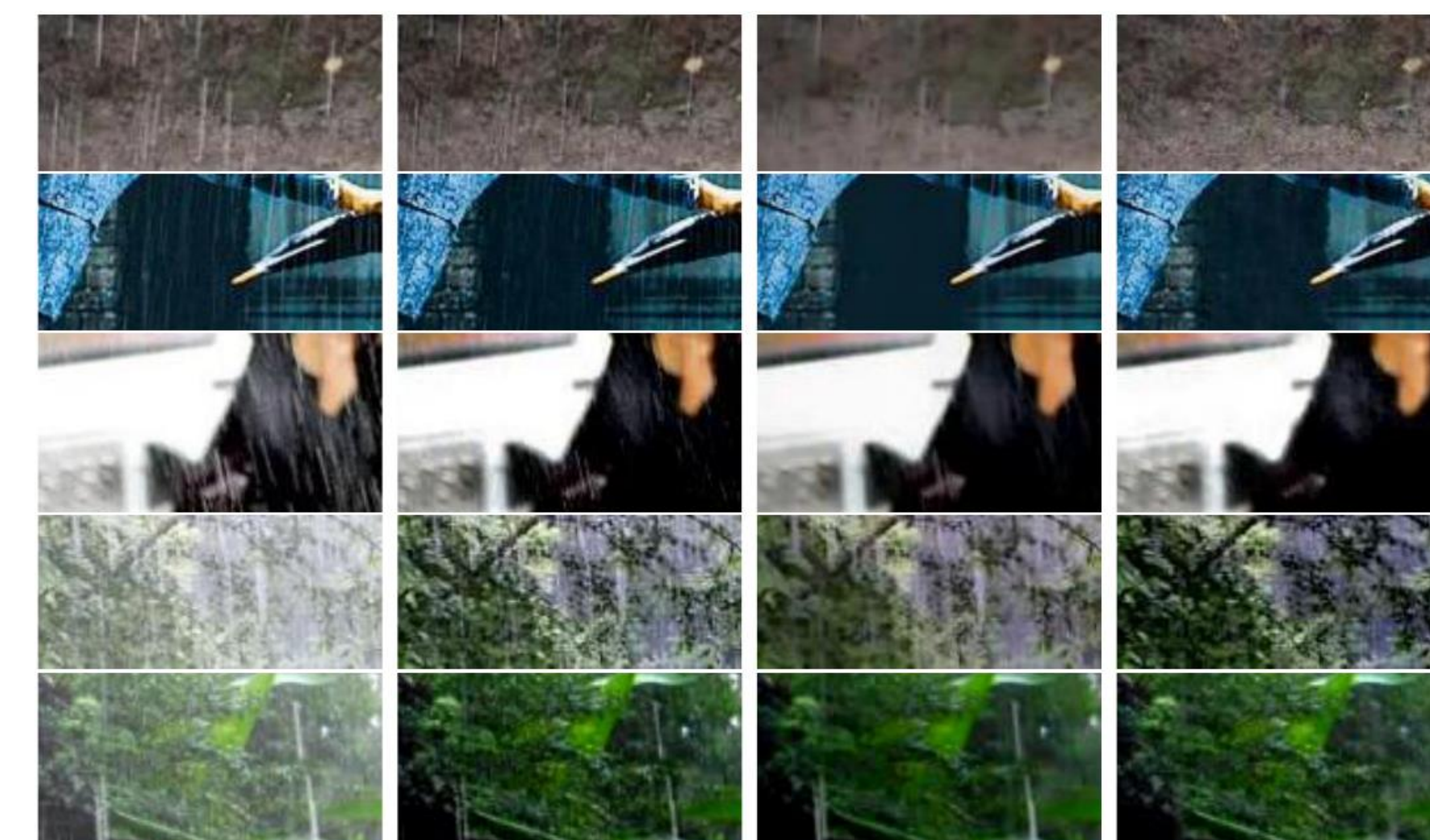- Increasingly larger receptive fields.

● Multi-Path Dilation Convolutions
- Filter at different scales
- P_1: 5×5
- P_2: 9×9
- P_3: 13×13

Experiment Results

1. Y. Li, *et al.* Rain streak removal using layer priors. CVPR, 2016.
2. Y. Luo, *et al.* Removing rain from a single image via discriminative sparse coding. ICCV, 2015.

● Visual comparison

Rain Images   DSC[1]   LP[2]   Ours

● Hard case

- For more details & codes, scan QR code or navigate
  http://www.icst.pku.edu.cn/struct/Projects/joint_rain_removal.htm
- Interested in our team STRUCT? Navigate to
  http://www.icst.pku.edu.cn/struct/struct.html