

Real-time rainy image restoration

Motivation

Rain removal is an important challenge in the field of computational imaging as rain streaks can cause serious image degradation. Rain causes streaks of different size, shape and direction. Some images can be hard to derain, especially in case of heavy and accumulated rain.

Deraining a video can be tackled by obtaining a sequence of images and comparing them to each other. Single image deraining can be a harder problem, as there are no other images to compare. Even obtaining a verified dataset of rainy and clear images can be challenging because of light shift, camera motions and motion artifacts.

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Related work

There are different deraining approaches from probabilistic approach[1] to matrix decomposition[2]. In this project, we will focus on deep learning methods for single-image deraining such as EDR, MPRNet and GT-rain[3].

The state of art methods use convolutional neural networks such as Dual Graph Convolutional Network, Residual Deep Learning[5] and Iterative Region Dependent Multi Task Learning[6] to tackle data loss and artifacts caused by rain streaks.

Most of the methods rely on synthetic data, generated by different algorithms like LBP-CGAN Rain Generation Method[4]. [3] proposed a dataset of real images, both clear and blurred by rain.

Objectives

Deraining remains a hard problem as even state of art methods struggle with reconstructing images in highly textured areas such as bricks and leaves. The aim of this project is to perform fast and efficient reconstruction of images, blurred by stochastic processes such as rain and snow.

Training on both real and synthetic data affects the performance of derainers. In this project, we are going to compare performance of multiple state of art derainers trained on synthetic, semi-real and real datasets like NYU-rain, SPA-data and GT-rain. We are going to measure how training on different datasets

affects various aspects of rainy images such as water droplets, rain streaks and background changes.

The recent study[7] showed that most of state-of-art derainers are very vulnerable against adversarial attacks. We would like to study the effect of training dataset on different convolutional neural networks ability to tackle both the rain region and object sensitive attacks.

The project will consist of the following steps:

1. Dataset collection. Work with simulated, semi-real and real datasets. Getting real images with highly textured areas for verification.
2. Implementation of derainers, training on datasets.
3. Verification and comparison of methods and datasets.

Milestones

1. Nov 16. Work with related papers, submission of the project proposal.
2. Nov 17 – Nov 20. Preparing the training datasets and real images.
3. Nov 20 – Nov 27. Implementation of derainers, training on datasets.
4. Nov 27 – Dec 4. Verification and comparison of the results.
5. Dec 4 – Dec 8. Finalizing the code, project submission.

References

1. A Probabilistic Approach for Detection and Removal of Rain from Videos
<https://go.gale.com/ps/i.do?id=GALE%7CA253368503&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=0974780X&p=AONE&sw=w&userGroupName=anon%7Ecb9e9cea>
2. Video Desnowing and Deraining Based on Matrix Decomposition
<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjM7OOcsa77AhUBJ30KHRR3AUIQFnoECBAQAQ&url=https%3A%2F%2Fieeexplore.ieee.org%2Fdocument%2F8099786&usg=AOvVaw2S1eqWttc4VMOvaAsZTHtO>
3. Not Just Streaks: Towards Ground Truth for Single Image Deraining
<https://arxiv.org/abs/2206.10779>

4. Research of Single Image Rain Removal Algorithm Based on LBP-CGAN Rain Generation Method

<https://downloads.hindawi.com/journals/mpe/2021/8865843.pdf>

5. Rain Streak Removal via Dual Graph Convolutional Network

<https://ojs.aaai.org/index.php/AAAI/article/view/16224>

6. Joint Rain Detection and Removal via Iterative Region Dependent Multi-Task Learning

https://www.researchgate.net/publication/308647428_Joint_Rain_Detection_and_Removal_via_Iterative_Region_Dependent_Multi-Task_Learning

7. Towards Robust Rain Removal Against Adversarial Attacks: A Comprehensive Benchmark Analysis and Beyond

https://www.researchgate.net/publication/308647428_Joint_Rain_Detection_and_Removal_via_Iterative_Region_Dependent_Multi-Task_Learning/citation/download