Simple Self-Distillation Learning for Noisy Image Classification

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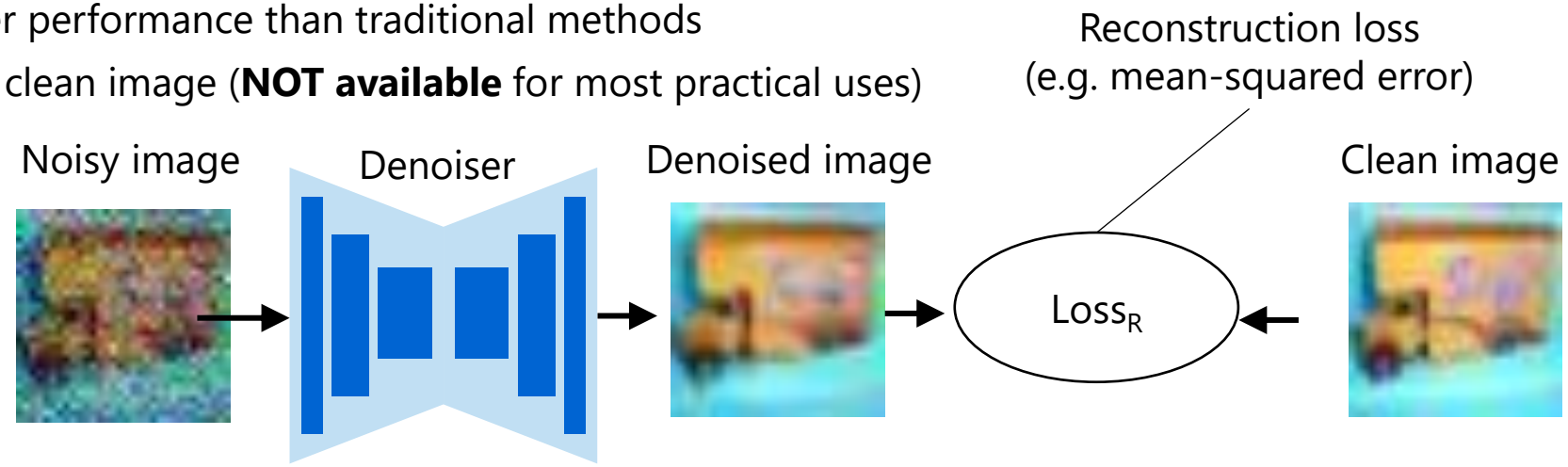
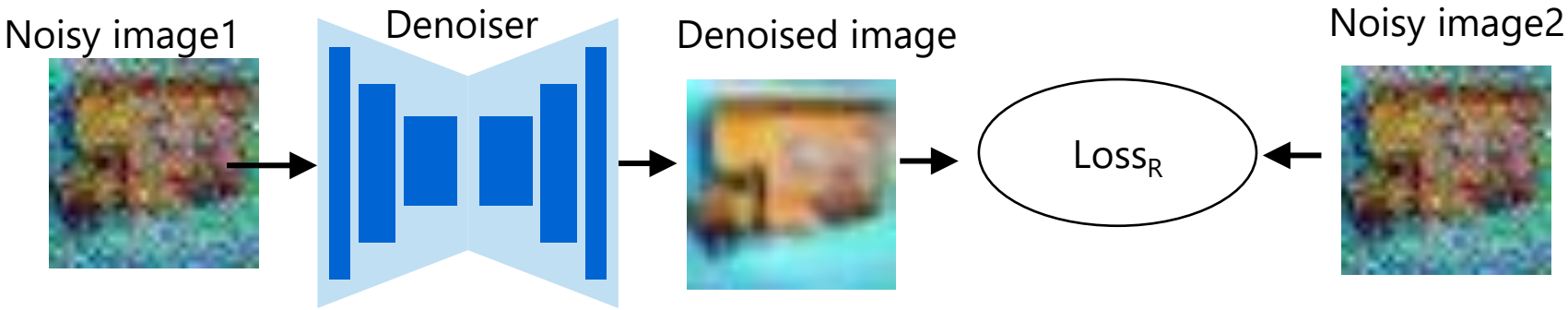
Introduction: Image Denoising for Noisy Image Classification

- Neural network denoiser using **clean** image
  - ✓ Higher performance than traditional methods
  - × Using clean image (**NOT available** for most practical uses)



- Training strategy using only **noisy** image (Noise2Noise[Lehtinen+,ICML2018])
  - ✓ Comparable performance to methods using clean image
  - × Blurry image (**NOT suitable** for image classification)



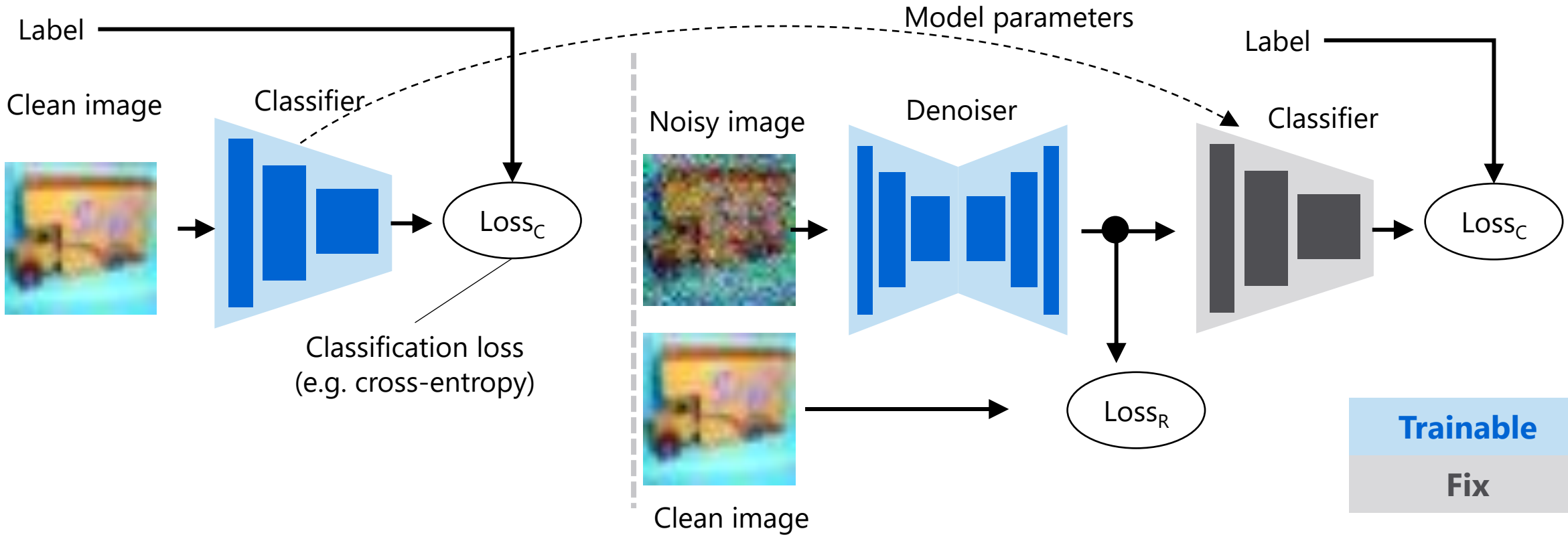
Proposed method overcomes both drawbacks

Prior Work (1): Joint Training[Liu+, IJCAI2018]

Training denoiser based on both image quality and performance on downstream task

Step1: Pre-training of classifier using clean image

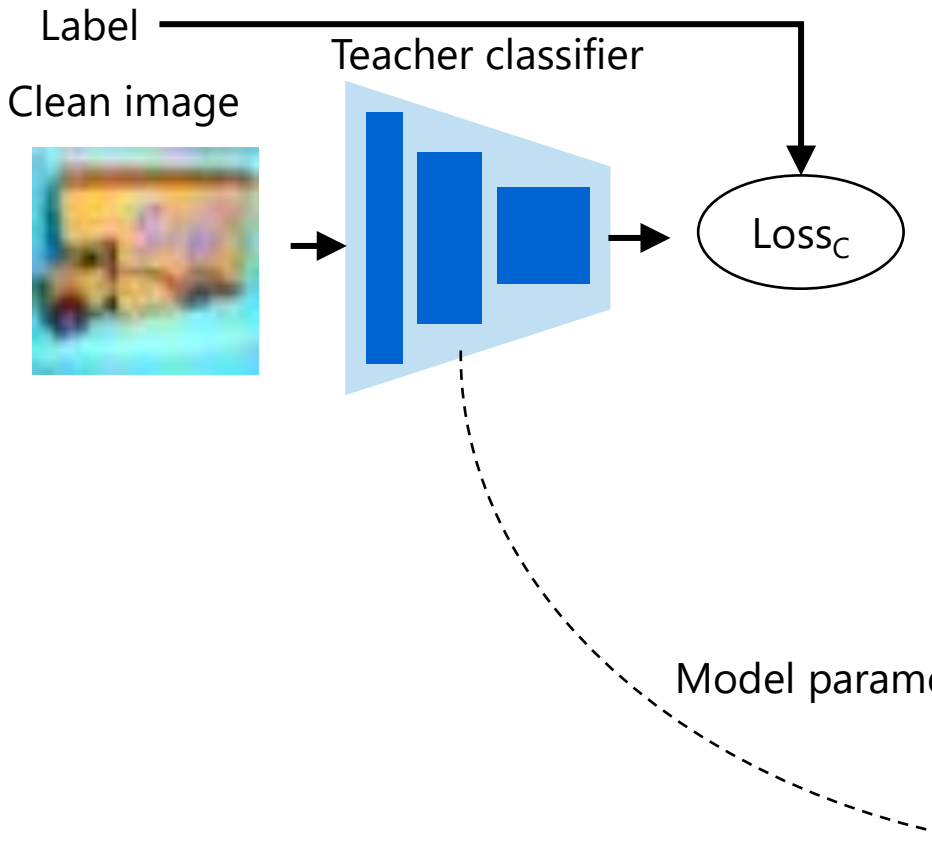
Step.2: Training of denoiser with Cascading pre-trained classifier after denoiser



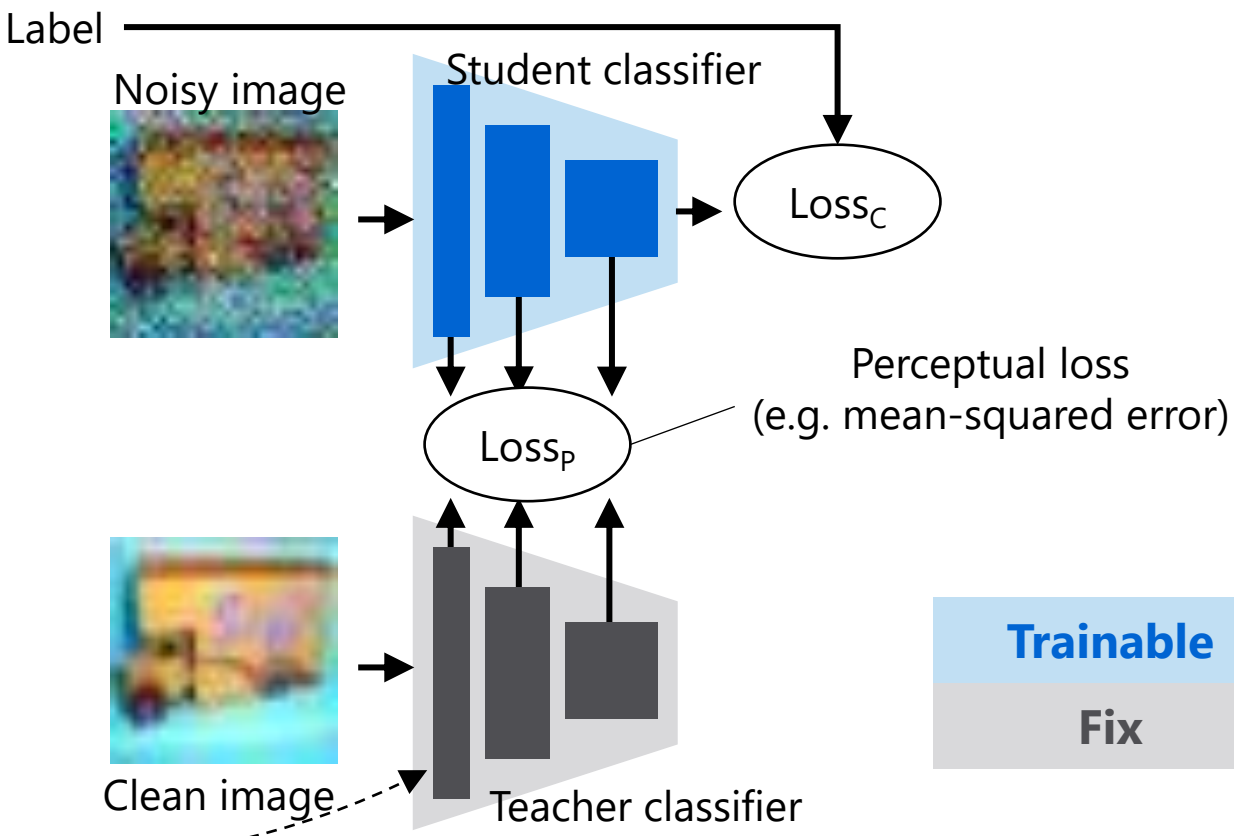
Prior Work (2): Student Teacher Learning[Gnanasambandam+, ECCV2020]

More direct way without denoiser inspired by knowledge distillation

Step1: Pre-training of teacher classifier using clean image



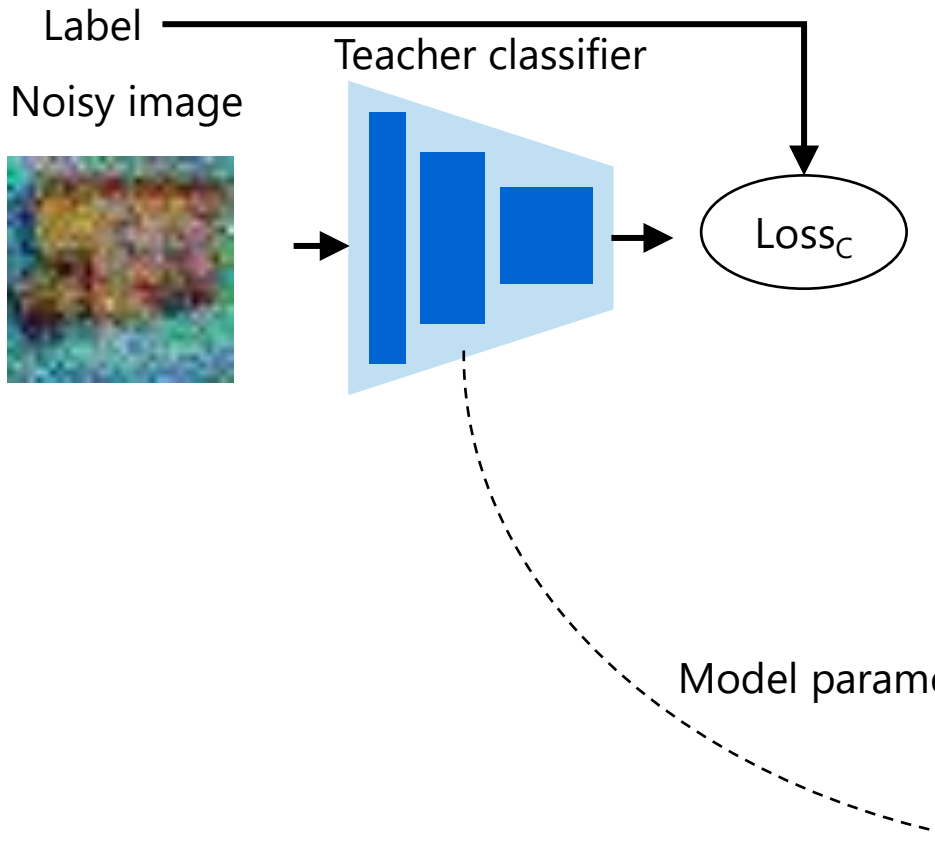
Step2: Training of student classifier using pre-trained teacher classifier



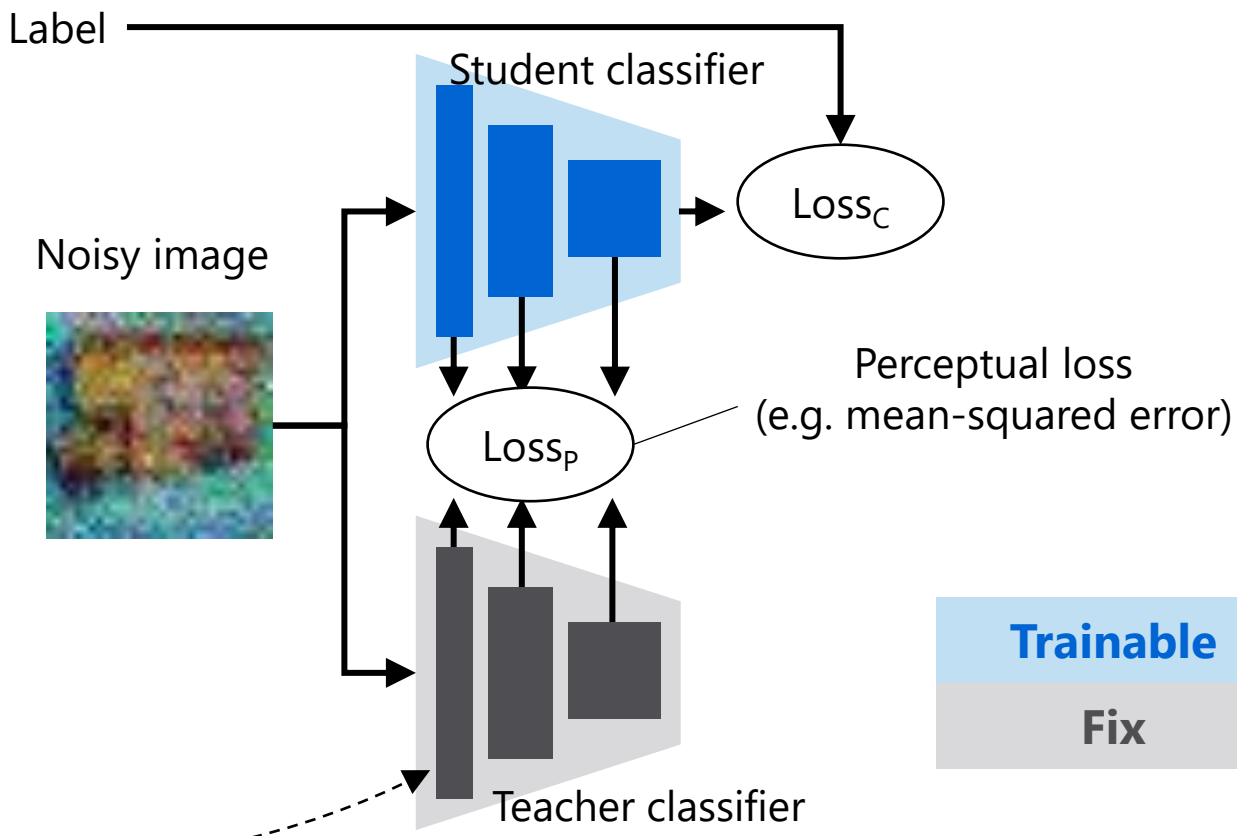
Proposed Method: Simple Self-Distillation Learning

- **Leveraging property of feature extractor that naturally removes unnecessary features**
- **Simply replacing clean image with noisy image in student-teacher learning**

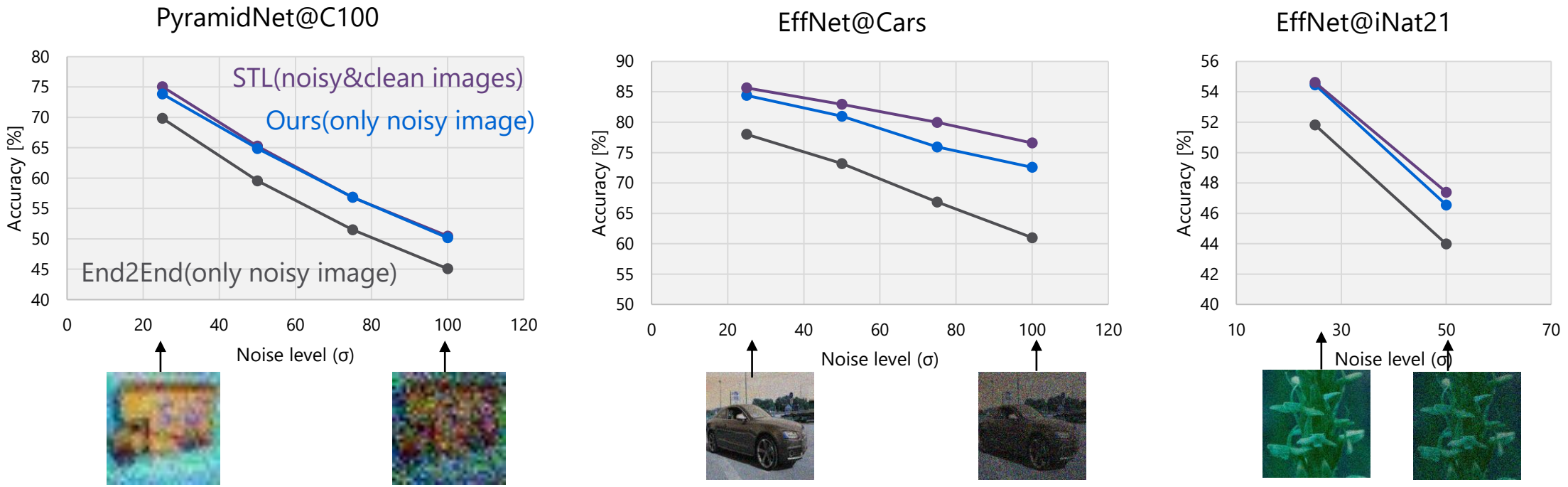
Step1: Pre-training of teacher classifier using noisy image



Step2: Training of student classifier using pre-trained teacher classifier



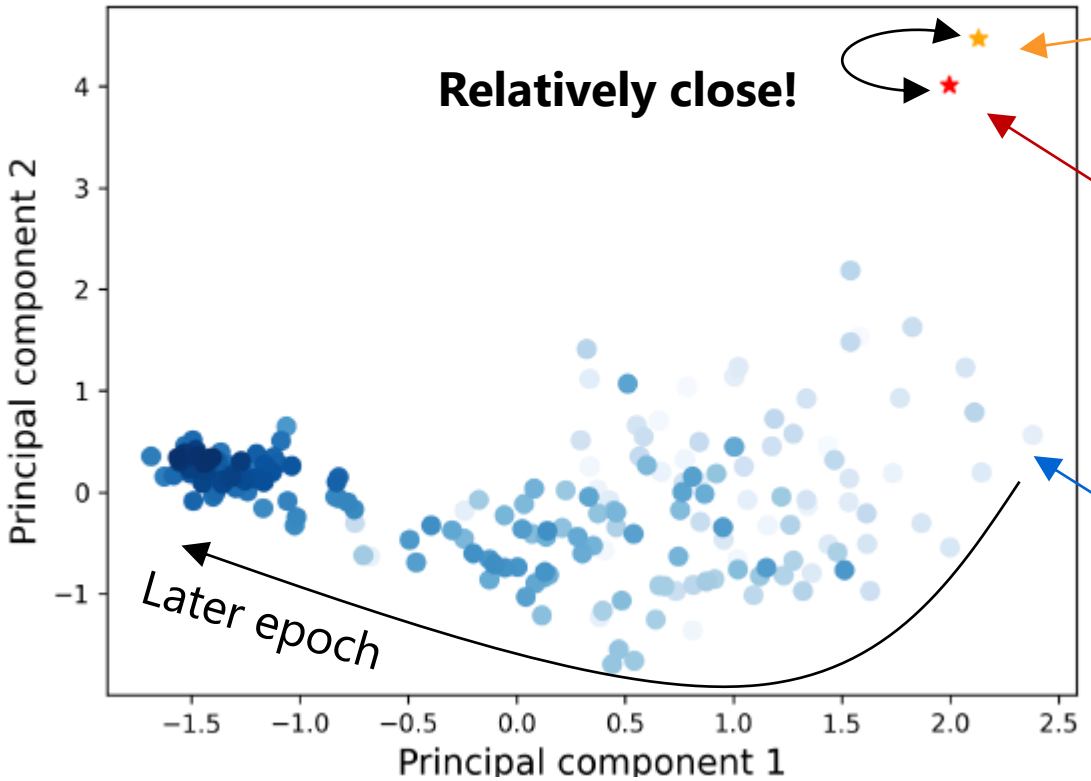
Results



Proposed method achieves comparable performance to STL
even without clean images

Qualitative Analysis

Feature space of a specific sample in CIFAR-10



Feature of a clean sample obtained by **clean teacher** in STL

Feature of a noisy sample obtained by **noisy teacher** in our method

Features of noisy samples obtained by student models in our method

Quality of noisy teacher is comparable to that of clean teacher

Summary

- Our method: **simple self-distillation learning**
  - Without explicit image denoising
  - Without clean image
- Results on noisy image classification task
  - Comparable performance to prior method using clean image
- Future work
  - Theoretical analysis
  - Investigation on other tasks