Range Image Based Point Cloud Colorization Using Conditional Generative Model

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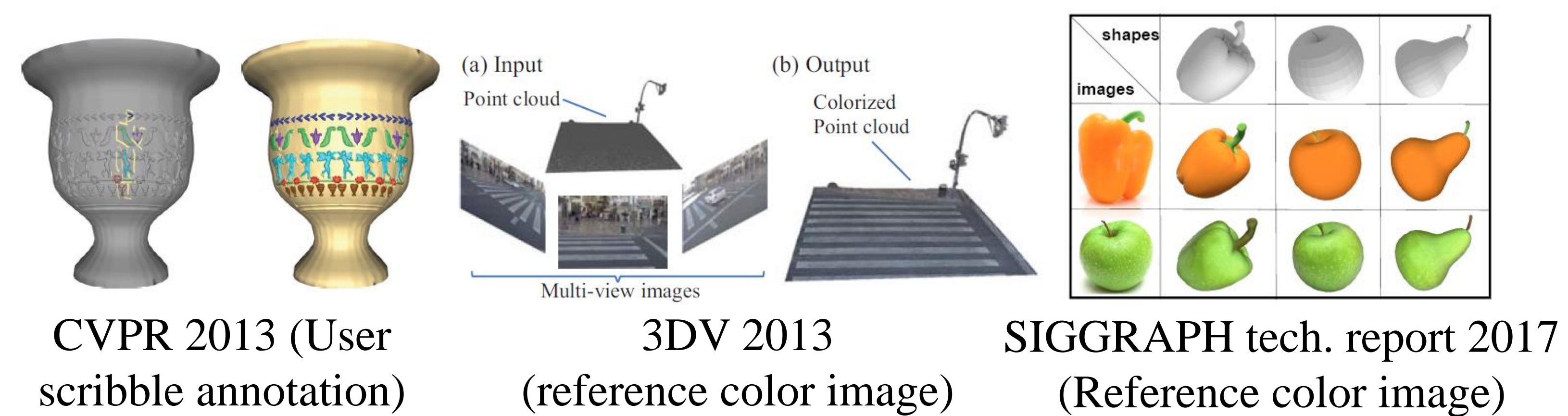### SCSE, Nanyang Technological University

Abstract

Nowadays, three-dimensional (3D) point cloud has been an emerging medium to represent real-world scenes and objects. However, there is a considerable proportion of point clouds whose color attribute information is not captured during the acquisition process due to the device or environment limitations. This poses a great challenge for efficient management and utilization of point clouds. To address this problem, we introduce an automatic colorization scheme based on a deep generative network for 3D point clouds. The proposed approach uses the range images of point could geometry and trains a conditional generative adversarial network to predict the color of those images. Later, the color of each pixel in the colorized image is projected back to its corresponding point in the 3D point cloud. The experimental results demonstrate the efficacy of the proposed colorization approach in facilitating users to recognize and handle 3D point cloud data better.

Introduction

Due to the limitation of point cloud acquisition process, there is a considerable proportion of point clouds whose color attribute information is not captured. However, research on 3D point cloud colorization is relatively limited.

CVPR 2013 (User scribble annotation)
3DV 2013 (reference color image)
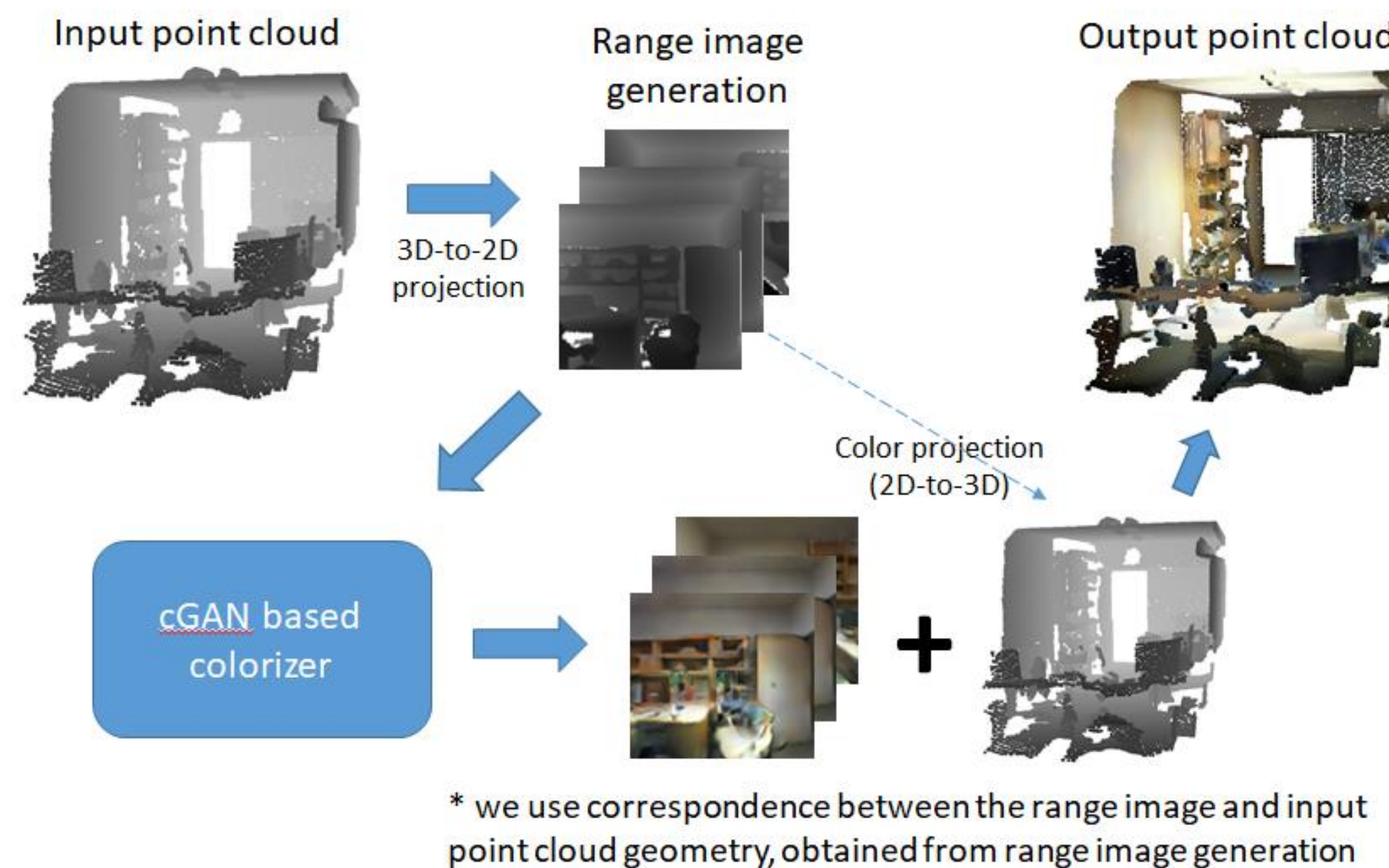SIGGRAPH tech. report 2017 (Reference color image)

Figure 1. Two popular 3D object colorization method based on reference information: (a) scribble-based method, (c) and (b) color transfer method.

Conditional GAN based color generator

- We apply conditional GANs (cGANs) to generate color attribute from the input. We use Pix2pix architecture (CVPR 2017) to implement our color generator. (RGB-D data from S3DIS dataset)

Proposed Colorization Method

Input point cloud → Range image generation → 3D-to-2D projection → cGAN based colorizer → + → Color projection (2D-to-3D) → Output point cloud

* we use correspondence between the range image and input point cloud geometry, obtained from range image generation
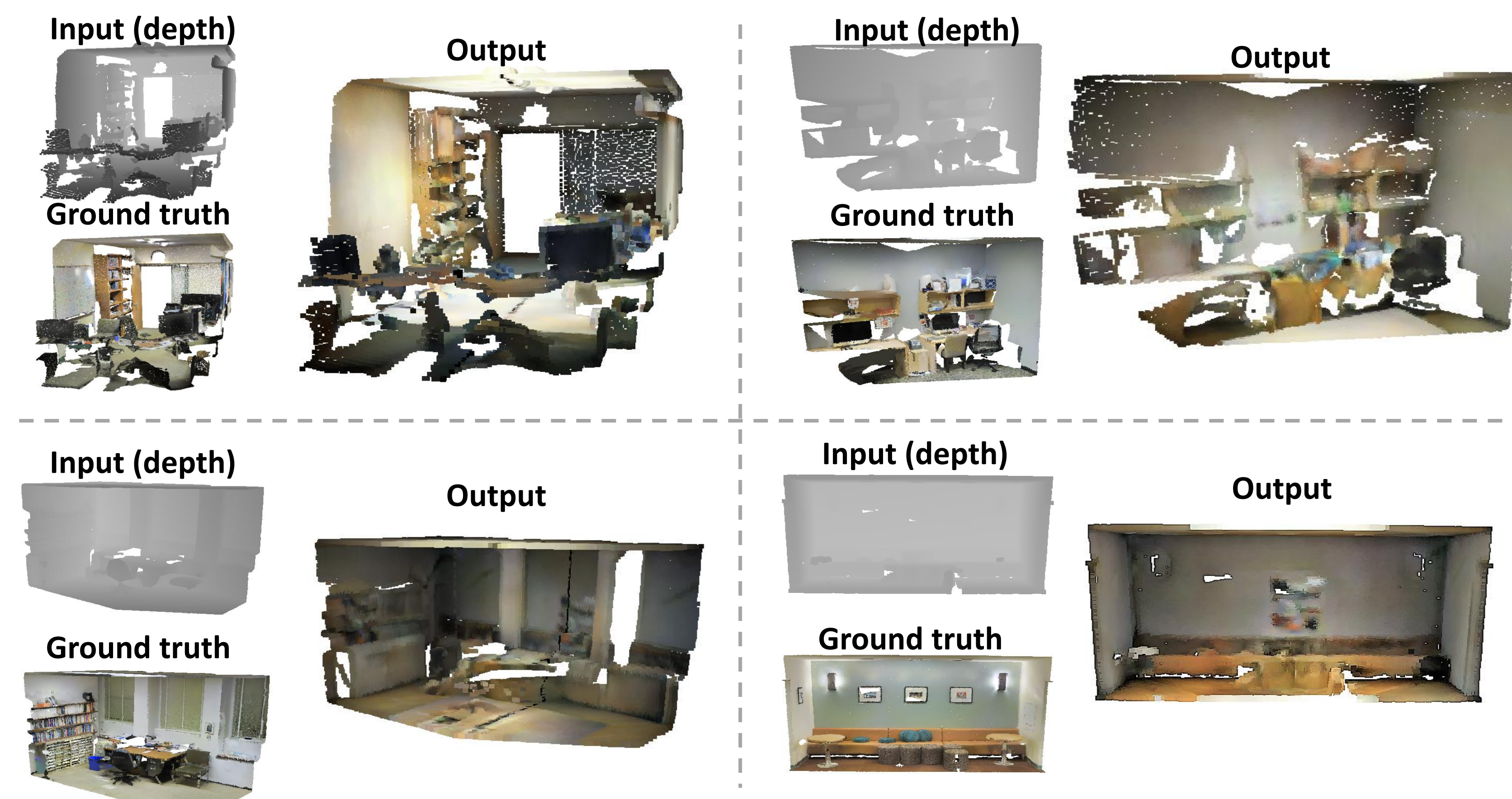
- Range (depth) image based point cloud colorization
  1. Range image generation from a point cloud
  2. Color attribute generation using conditional GAN (cGAN)
  3. Color attribute projection and merging

Test Summary and Samples

Original
Depth
Colorized

3D geometry of *S3DIS Area 4* (22 point clouds for each office)

Input (depth) Output Ground truth

Limitation

Ambiguity of input depth map
Color mismatch from separated range images