Supplementary Materials:
Self-Supervised Vessel Segmentation via Adversarial Learning

1. Additional Detail for Ablation Study

In order to better illustrate the impact of different architectures and loss functions, we present visualization results of ablation study in Figure 1. The second to fifth rows show generated samples of four different setups.

In the first column, $groundtruth$ indicates the groundtruth segmentation map of the input coronary angiogram $realY$, and $fakeX$ presents predicted segmentation maps of the input coronary angiogram $realY$ with different setups. As discussed in ablation study, using attention-guide generator and segmentation loss extensively improves the performance of vessel segmentation.

The column $fakeY$ presents fake coronary angiograms of the input fractal segmentation map $realX$, and the column $recY$ presents reconstructed coronary angiograms of the input coronary angiogram $realY$. Removing attention-guided generator makes fake coronary angiograms become unrealistic and reconstructed coronary angiograms become blurry.

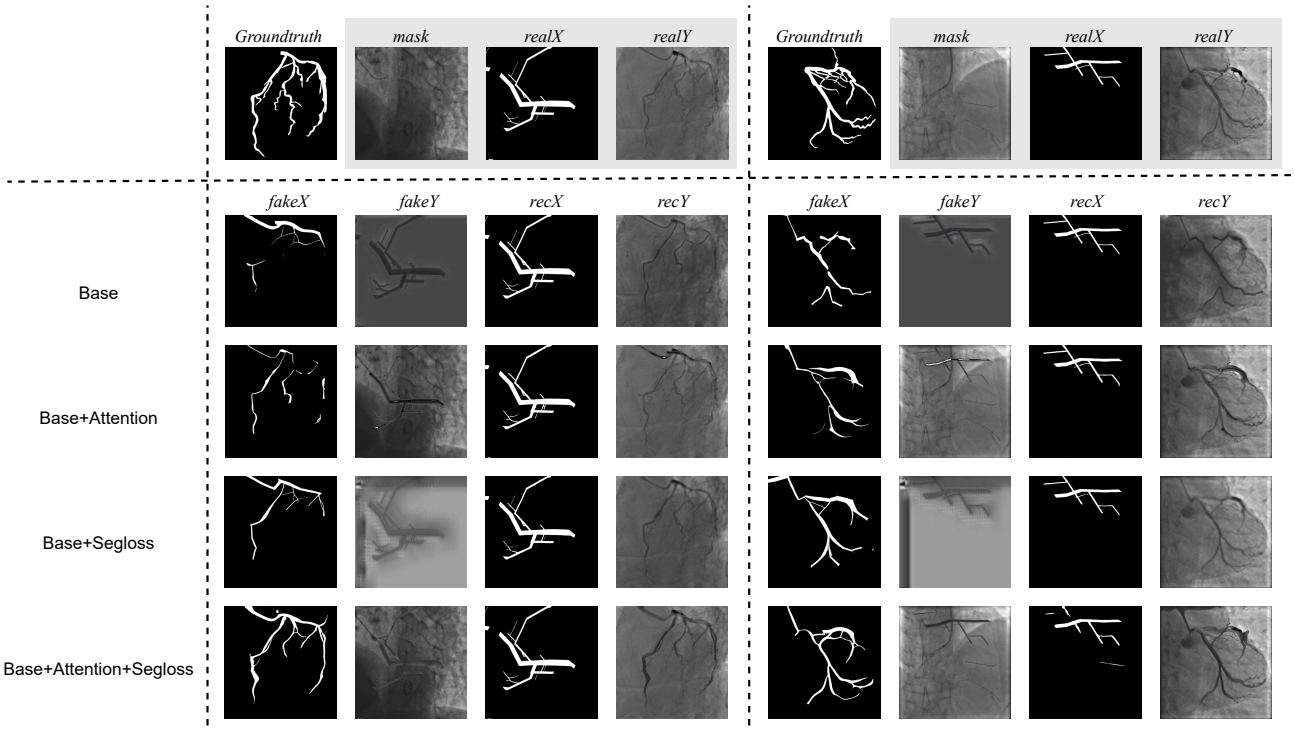

Figure 1: Visualization results of ablation study. The first row are groundtruth and inputs. An input consists of a mask frame $mask$, a fractal segmentation map $realX$, and a coronary angiogram $realY$, as shown in the gray rectangle of the figure. Row 2-5 are generated samples of different setups. The column $fakeX$, $fakeY$, $recX$, $recY$ present segmentation maps of $realY$, coronary angiograms of $realX$, reconstructed segmentation maps of $realX$, and reconstructed coronary angiograms of $realY$, respectively.

2. Fractals for Self-supervised Learning

In our current experiments, we design fractal synthesis based on the characteristics of x-ray coronary angiograms. We use rectangle with branches ($realX$) to mimic vessel with branches ($realY$). The details of drawing parameters is a width (ranges from 15 to 25) and a length (ranges from 350 to 450) of the main rectangle with a branch iteration (ranges from 3 to 5). Each rectangle has two branches with randomly size of $1/4$ to $3/4$. The scale of affine ranges from 0.1 to 0.15, and the rotation ranges from -30 to 30. In addition, the details can be adjusted according to different tasks.

Figure 2 shows example fractals that synthesized by the fractal synthesis module. These fractals are used as segmentation maps $realX$ for self-supervised vessel representation learning. We simultaneously synthesize fake vessels and segment vessels out of coronary angiograms by unpaired image-to-image translation between segmentation maps and coronary angiograms.

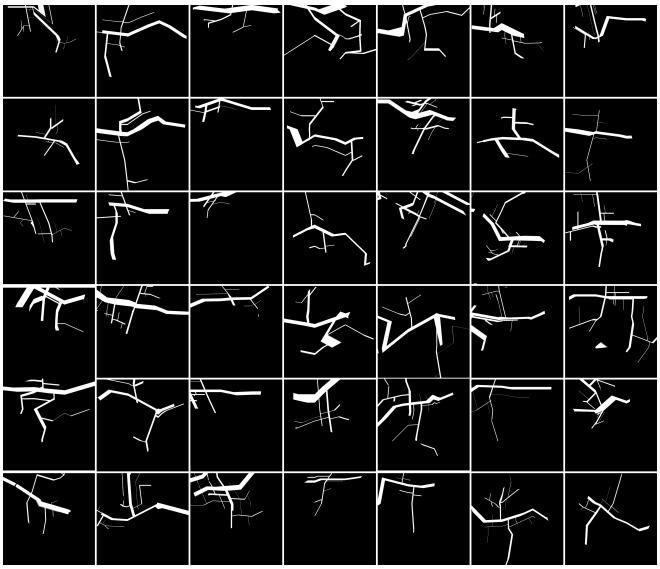

Figure 2: Visualization of example fractals.