(a) Framework

DINOv3 Features

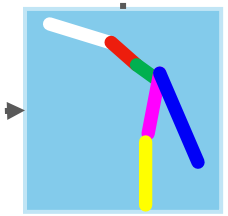
Conv1

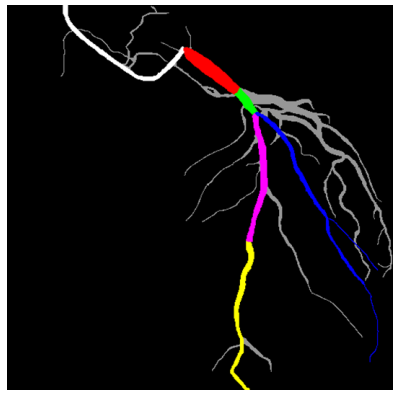
Conv2

Decoder

Key points queries

Key Point Network





(b) Key Point Network

Key points queries

Q

K, V

Image features

Cross-attention blocks

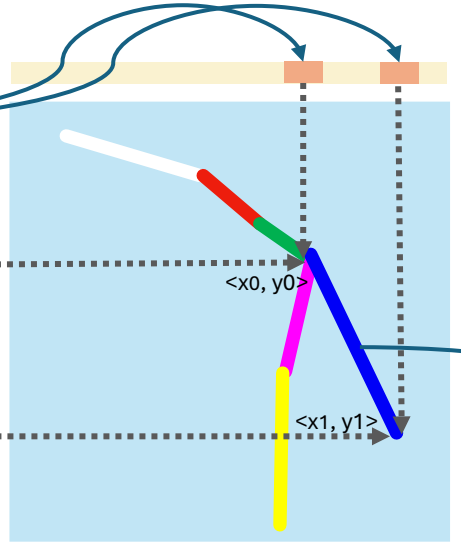
Key points representation

Horizontal Coordinate Classifier

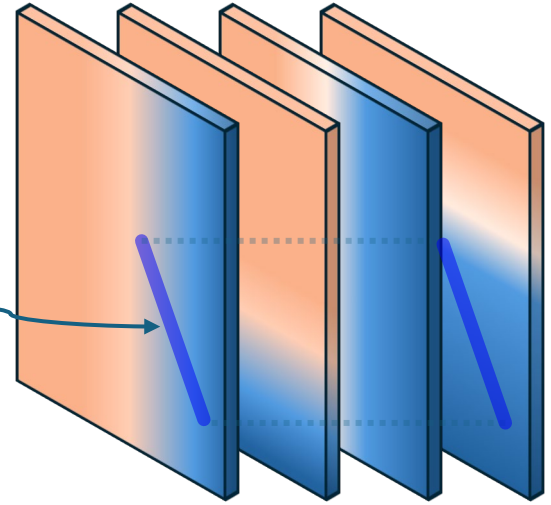
Vertical Coordinate Classifier

Vessel Solidness Classifier

(c) Differentiable Skeleton



Key points distance map



s*(x – x1) s*(y – y1) s*(x – x0) s*(y – y0)