Longitudinal mapping of transportation infrastructure with spatio-temporal generative modeling

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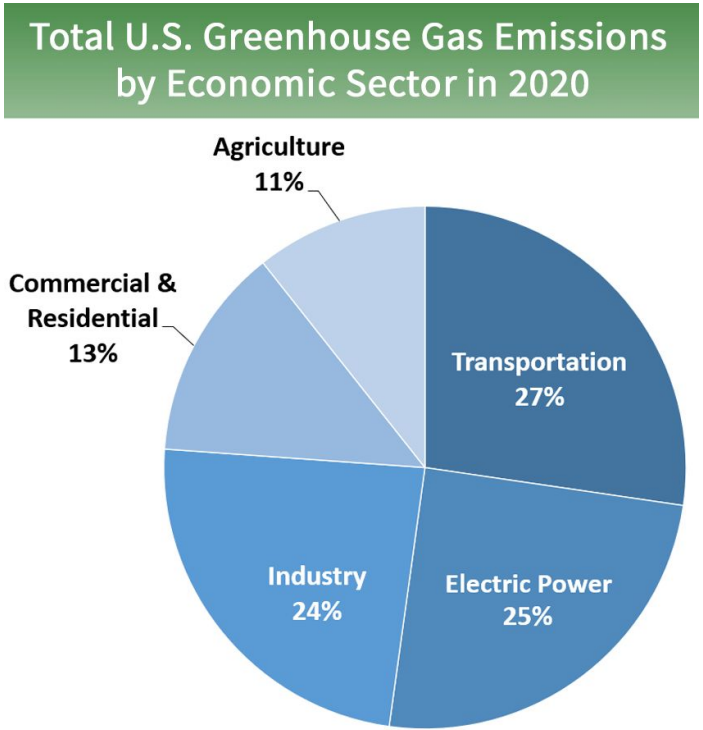
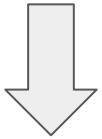
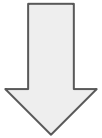
Transportation Infrastructure & Climate Change



Improve road safety



More walking & public transit



Reduce global emissions!

Better transportation design can save lives

43k *annual transportation-related deaths*

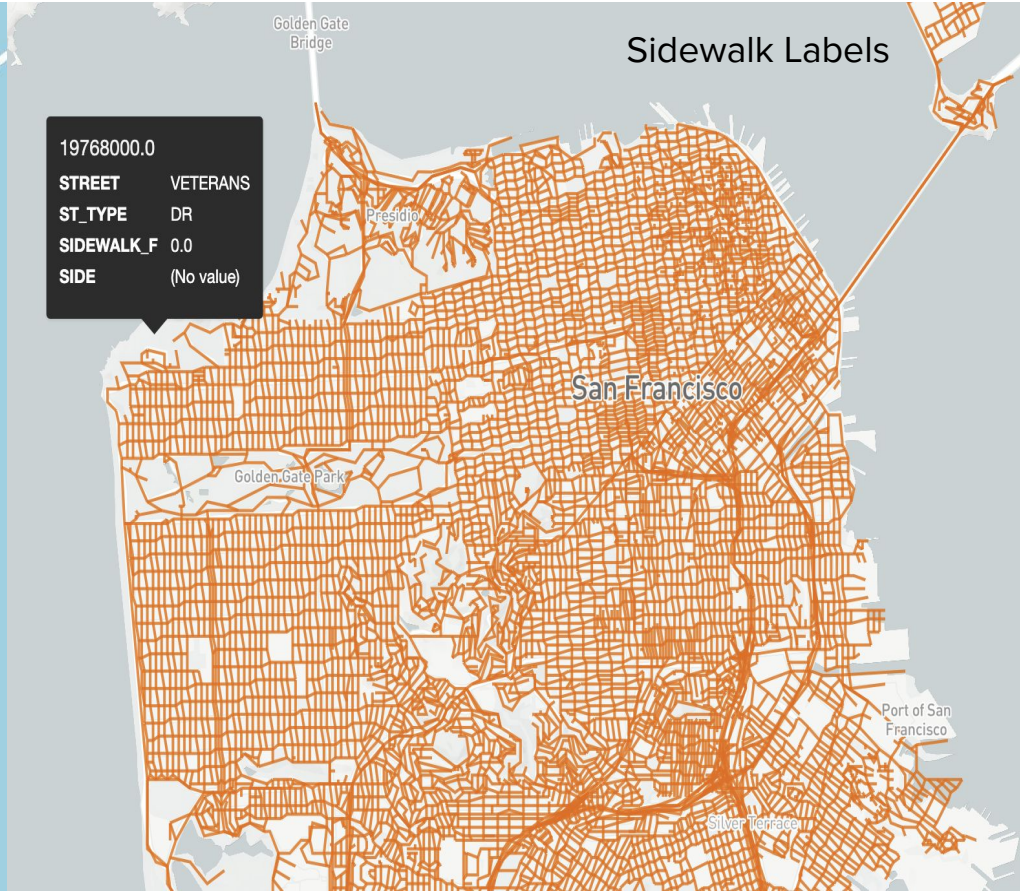
National Highway Transportation Safety Administration, 2021

Our lab's previous work

Li et al. (2021) identified changes in intersection-level marked crosswalks in the US over a 14-year period.

Can we extend this approach to map other infrastructure at an even larger scale?

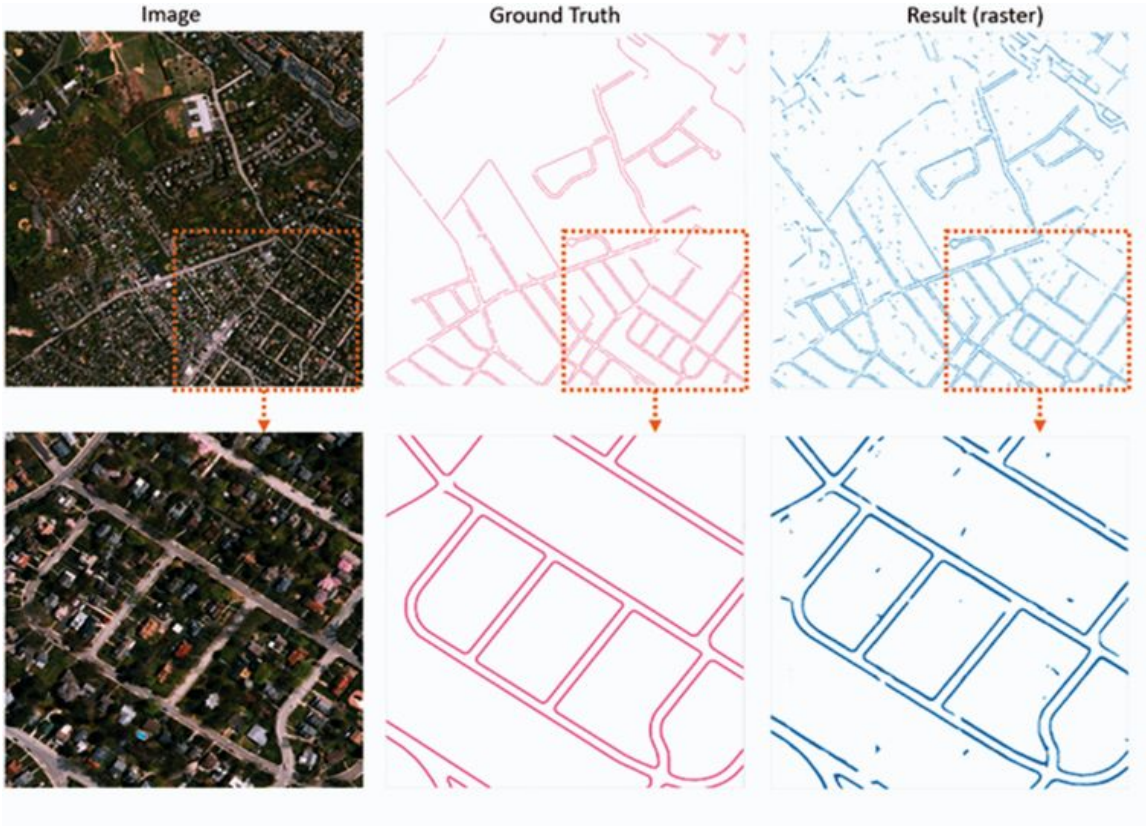
We have some labels for bike lanes and sidewalks!



Previous work mapping sidewalks with high resolution imagery

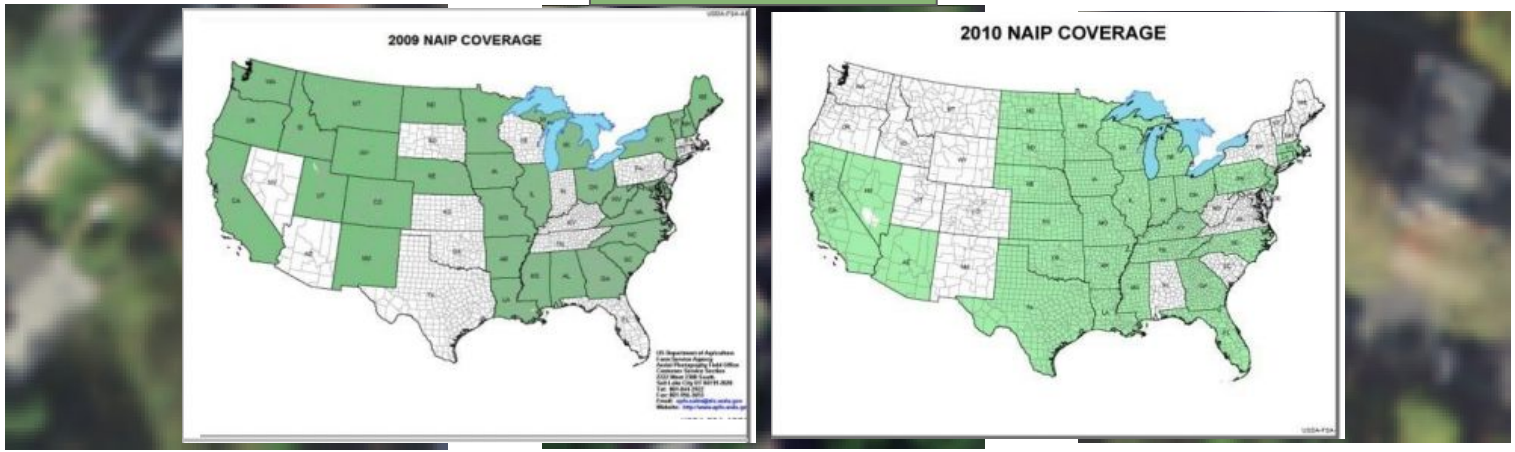
Ning et al. (2021) used aerial imagery and street view imagery to map sidewalks.

- Limited to 4 counties.



NAIP is longitudinal imagery available throughout the U.S. but…

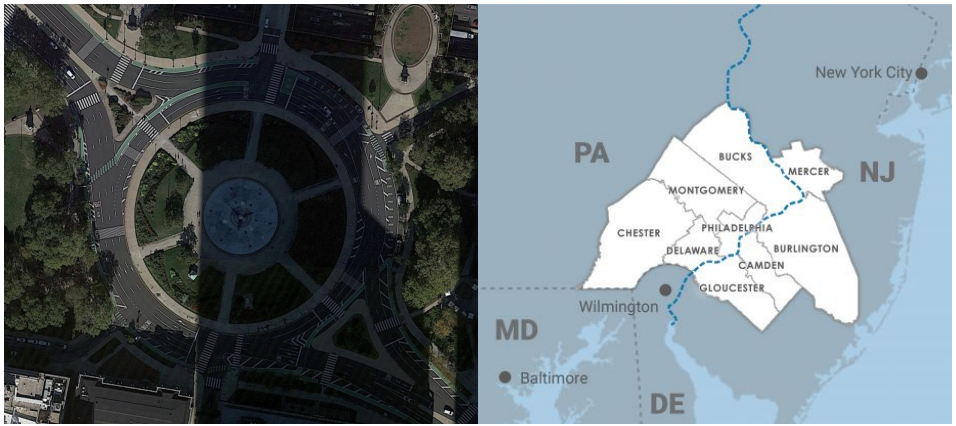
Clearest Image



Spatial resolution is too low (1m) to see transportation infrastructure

However, we have...

DVRPC



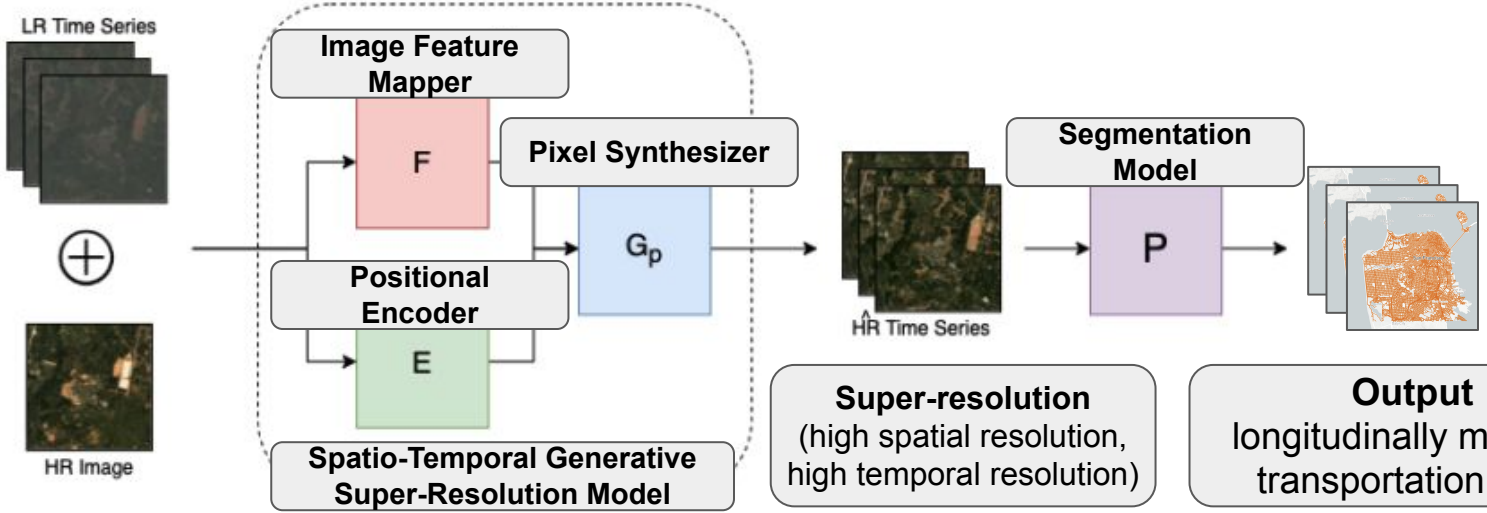
Very high resolution imagery in 9 U.S. counties where infrastructure is much more clear

Google

A single snapshot of very high resolution imagery everywhere in the U.S.

Spatio-Temporal Super-Resolution Model

NAIP
(low spatial resolution,
high temporal resolution)



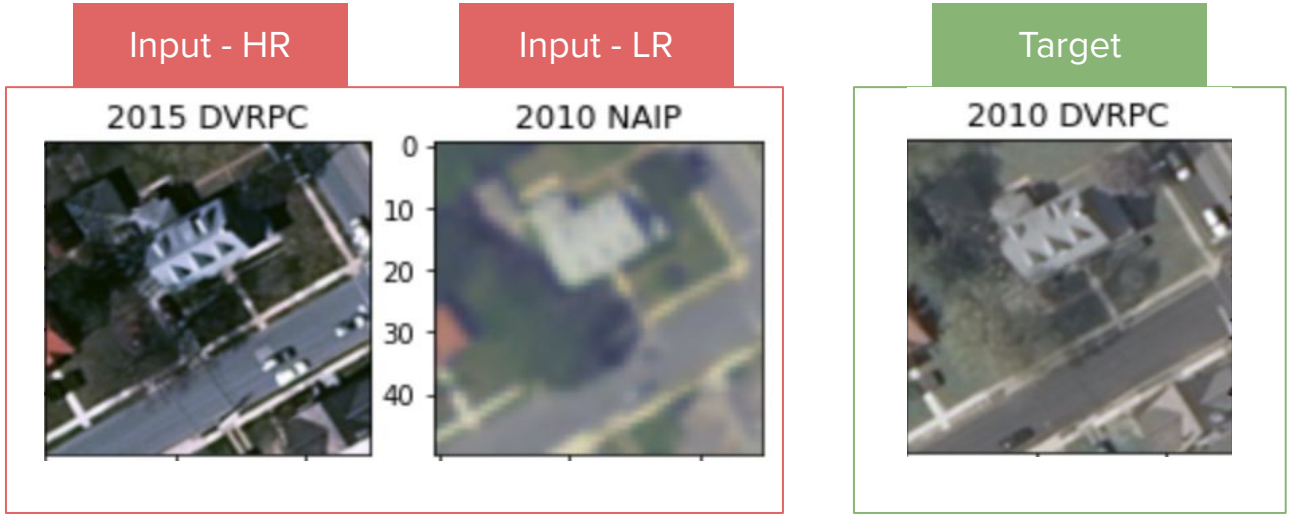
Super-resolution
(high spatial resolution,
high temporal resolution)

Output
longitudinally mapped
transportation infra

DVRPC
(high spatial resolution,
low temporal resolution)

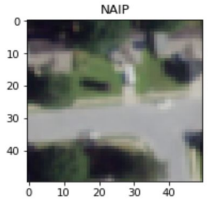
He et al. Spatial-Temporal Super-Resolution of Satellite Imagery via Conditional Pixel Synthesis. *NeurIPS 2021.*

We made the largest ever super-resolution dataset of remotely sensed imagery at sub-meter resolution

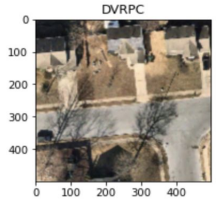


180k DVRPC/NAIP Triplets

Segmentation dataset of 160k pairs to test super-resolved images

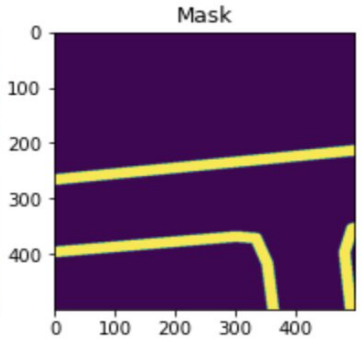


NAIP (Baseline)



DVRPC (Ceiling)

Super-resolved



Baseline Results for Segmentation Model

Imagery	IoU	F1
DVRPC (Ning et al.)	-	0.635
DVRPC (Ours)	.588	.612
NAIP (Ours)	.448	.506

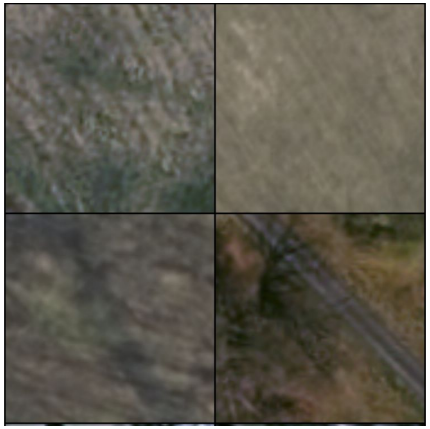
Input

Target Mask

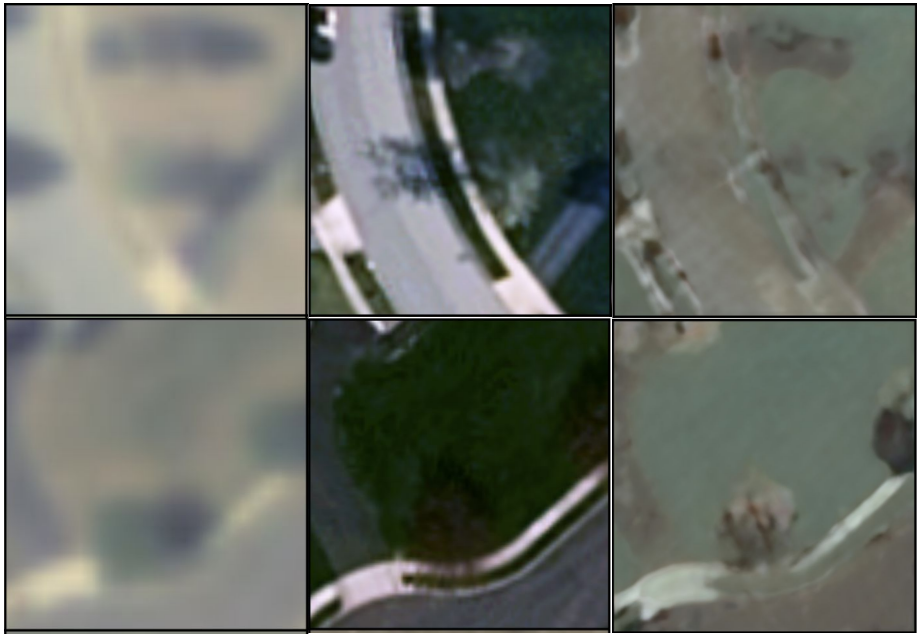
Prediction

Preliminary Spatio-Temporal Model Results

Imagery	SSIM
Texas Housing (He et al.)	.533
DVRPC + NAIP (Ours)	.653



Input - LR	Input - HR	Output - H^R



Acknowledgements

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Thank you!