SIMON FRASER UNIVERSITY

CVPR is a contemporary art exhibition
-- Garbage is a source for impact --

3D Scene Understanding for Vision, Graphics,
and Robotics Workshop @ CVPR2020

Yasutaka Furukawa

We are scared of reviewers…

CVPR is a contemporary art exhibition
-- Garbage is a source for impact --

3D Scene Understanding for Vision, Graphics, and Robotics

CVPR 2020 Workshop, Virtual, June 15th, 2020

News

Due to the pandemic, our workshop will totally be virtual this year. We will host an online chat room for communication with the speakers and Q&A. The details are coming soon. Looking forward to meet you online!.

Invited talks and oral presentations will be presented live or by recorded videos in the same Zoom room, all of the talks will have live Q&A session, please refer to the Program for recorded videos and more details.

Invited Speakers

Kristen Grauman (UT Austin)

Sergey Levine (UC Berkeley)

Andreas Geiger (University of Tübingen)

Yasutaka Furukawa (Simon Fraser University)

Daniel Ritchie (Brown University)

Jeannette Bohg (Stanford University)

Shuran Song (Columbia University)

Andrea Tagliasacchi (Google Brain)

Katerina Fragkiadaki (Carnegie Mellon University)

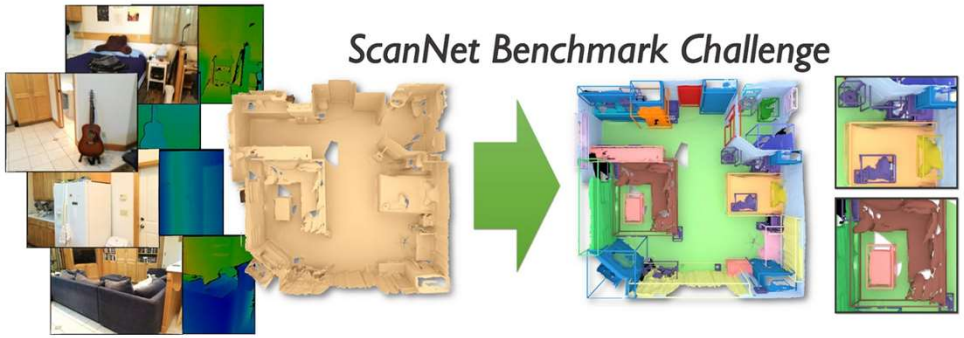
Opening Remark

David Forsyth (University of Illinois Urbana-Champaign)

ScanNet Indoor Scene Understanding Challenge

CVPR 2020 Workshop, Seattle, WA

June 19, 2020



Introduction

3D scene understanding for indoor environments is becoming an increasingly important area. Application domains such as augmented and virtual reality, computational photography, interior design, and autonomous mobile robots all require a deep understanding of 3D interior spaces, the semantics of objects that are present, and their relative configurations in 3D space.

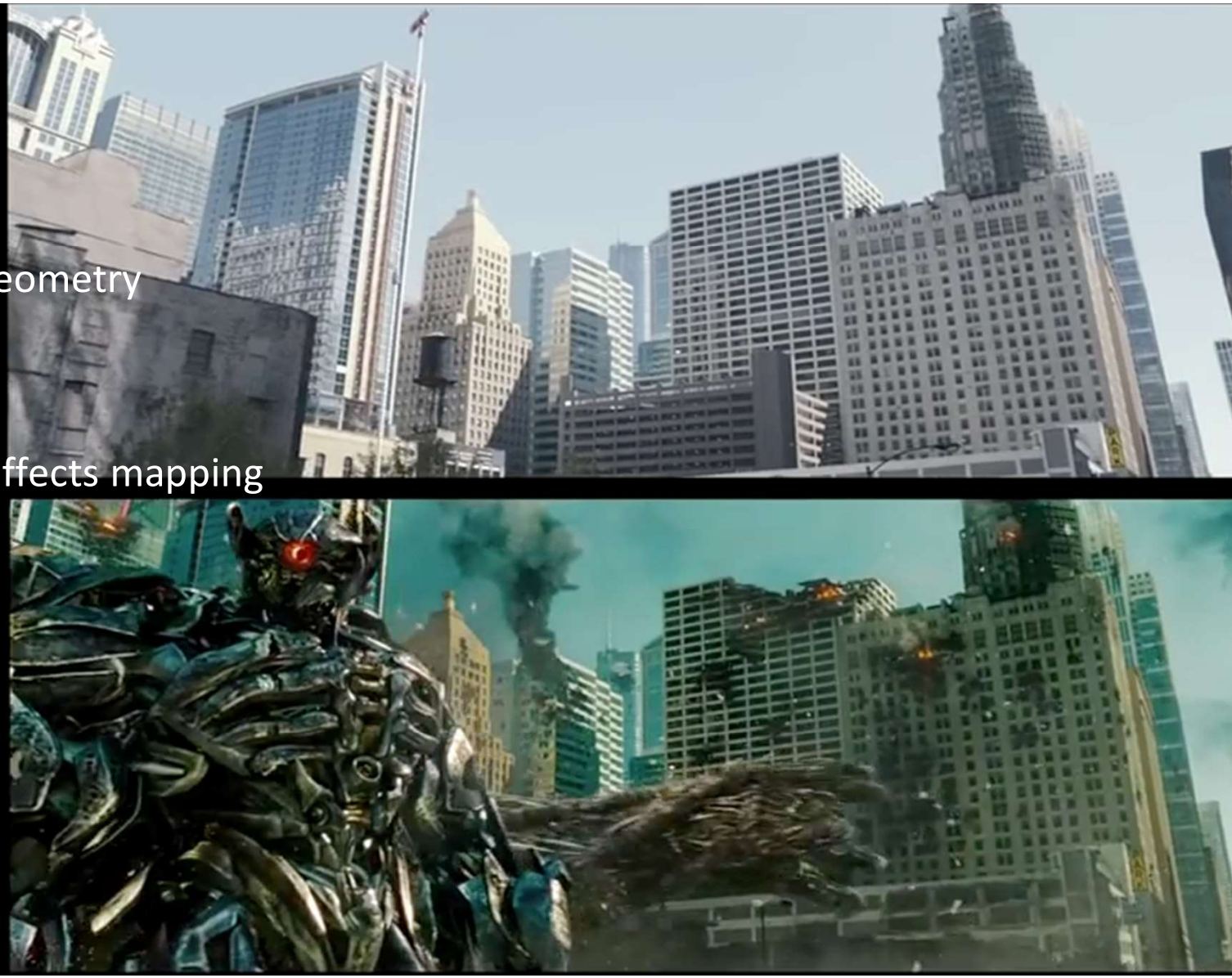
We present the first comprehensive challenge for 3D scene understanding of entire rooms at the object instance-level with 5 tasks based on the ScanNet dataset. The ScanNet dataset is a large-scale semantically annotated dataset of 3D mesh reconstructions of interior spaces (approx. 1500 rooms and 2.5 million RGB-D frames). It is used by more than 480 research groups to develop and benchmark state-of-the-art approaches in semantic scene understanding. A key goal of this challenge is to compare state-of-the-art approaches operating on image data (including RGB-D) with approaches operating directly on 3D data (point cloud, or surface mesh representations). Additionally, we pose both object category label prediction (commonly referred to as semantic segmentation), and instance-level object recognition (object instance prediction and category label prediction). We propose five tasks that cover this space:

- **2D semantic label prediction**: prediction of object category labels from 2D image representation
- **2D semantic instance prediction**: prediction of object instance and category labels from 2D image representation
- **3D semantic label prediction**: prediction of object category labels from 3D representation
- **3D semantic instance prediction**: prediction of object instance and category labels from 3D representation
- **Scene type classification**: classification of entire 3D room into a scene type

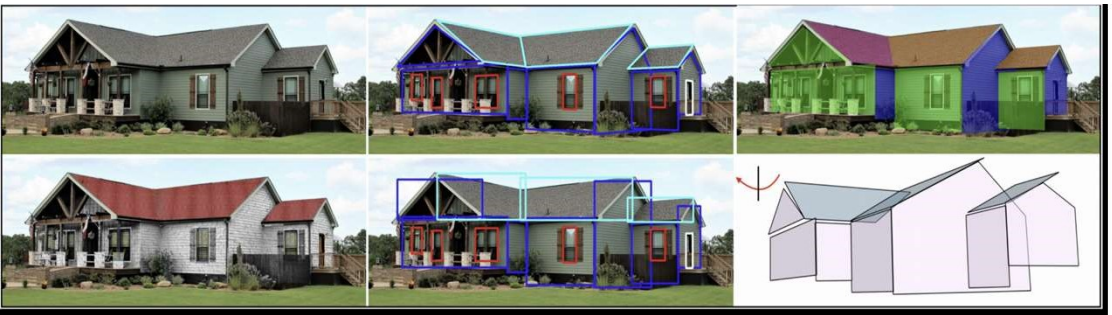
For each task, challenge participants are provided with prepared training, validation, and test datasets, and automated evaluation scripts. In addition to the public train-val-test split, benchmarking is done on a hidden test set whose raw data can be downloaded without annotations; in order to participate in the benchmark, the predictions on the hidden test set are uploaded to the evaluation server, where they are evaluated. Submission is restricted to submissions every two weeks to avoid finetuning on the test dataset. See more details at http://kaldir.vc.in.tum.de/scannet_benchmark/documentation if you would like to participate in the challenge. The evaluation server leaderboard is live at http://kaldir.vc.in.tum.de/scannet_benchmark/.

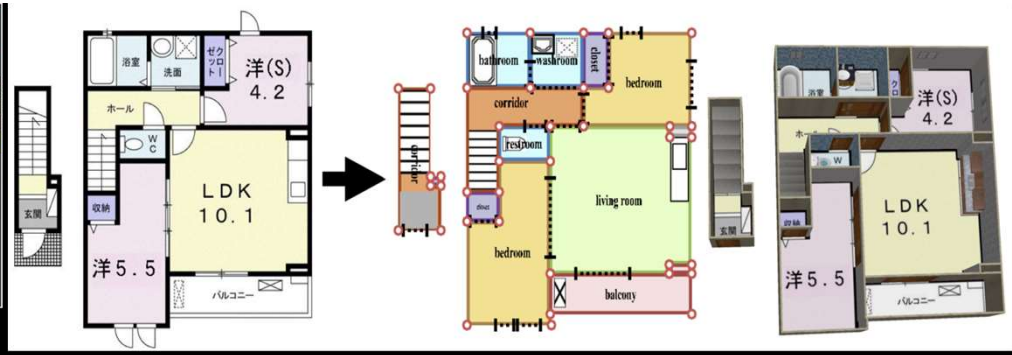
CAD model
Structured geometry
Semantically segmented geometry

- Model editing
- texture/normal/bump/effects mapping
- Physics simulations
- Interactions (VR/AR)
- Architectural analysis
- …

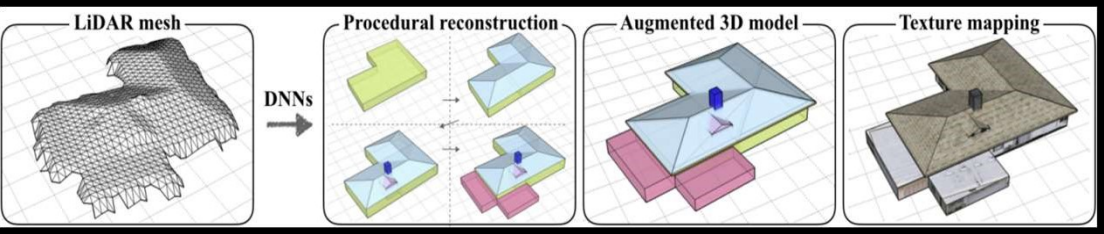


[Transformer]




浴室
洗面
ゼクロト
洋(S)
4.2
ホール
WC
収納
LDK
10.1
洋5.5
バルコニー
玄関
bathroom
washroom
closet
bedroom
corridor
Restroom
living room
balcony

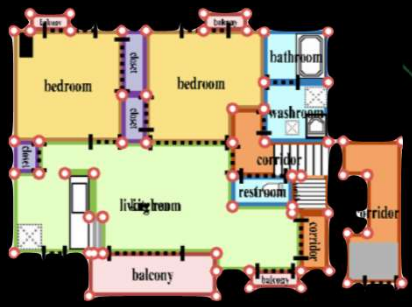
The Metropolitan Museum of Art


LiDAR mesh
DNNs
Procedural reconstruction
Augmented 3D model
Texture mapping

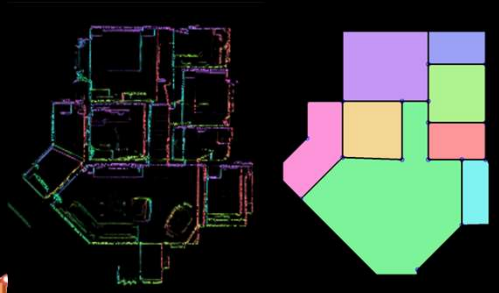
Structured Geometry Reconstruction

CVPR 2009

CVPR 2014

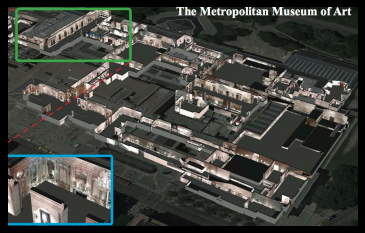


ICCV 2017

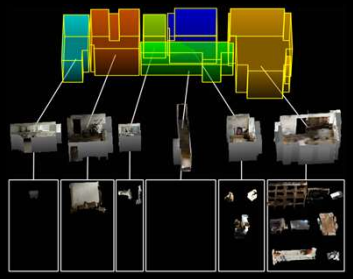


ECCV 2018/ICCV 2019

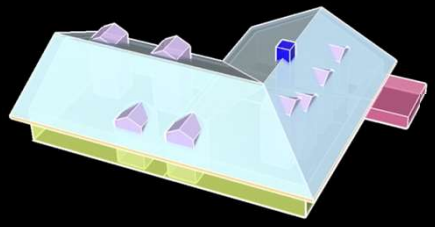
CVPR 2020



ECCV 2012



ICCV 2015



ECCV 2018

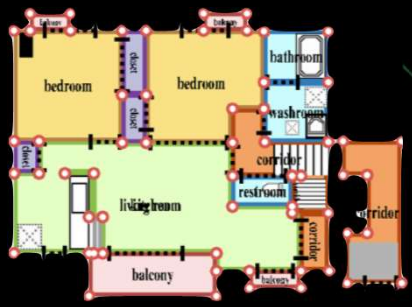
CVPR 2018/CVPR 2019

Ice-age

Revolution

CVPR 2009

CVPR 2014



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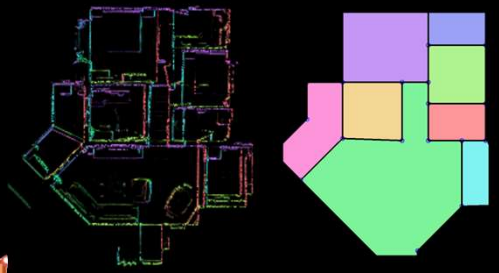

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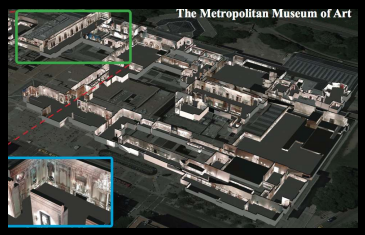

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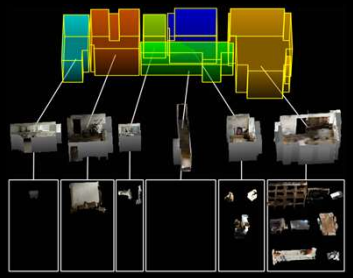
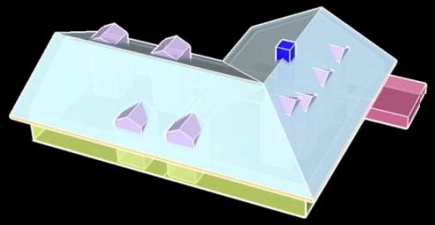


ICCV 2015



ECCV 2018

CVPR 2020

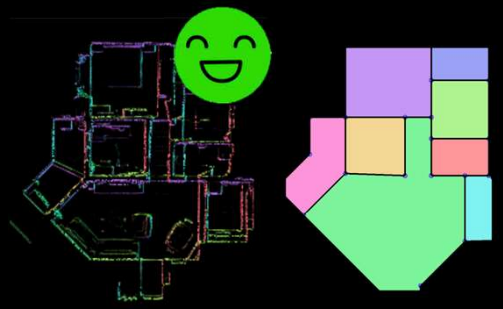
CVPR 2018/CVPR 2019

Ice-age (no impact) → Revolution (impact)

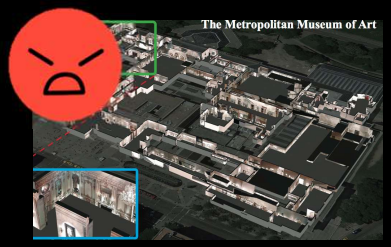
CVPR 2009

CVPR 2014

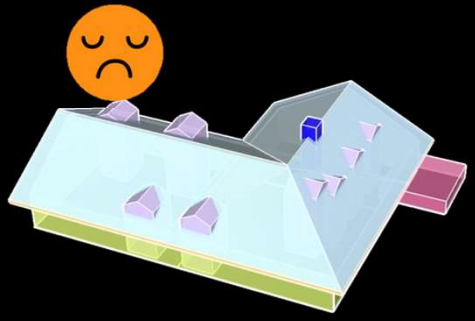
CVPR 2018/CVPR 2019



ECCV 2018/ICCV 2019



ECCV 2012



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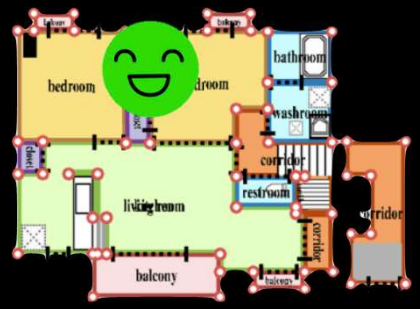

ICCV 2017

Aaron Hertzmann
June 8 at 9:19 AM ·

I've posted a new essay here which is the product of my recent attempts to better understand contemporary art. There are some pretty fundamental things here that I didn't get from any of the books that I read on this topic, nor from my undergraduate art degree.
I'm really grateful to **Jason Salavon** for all his time spent discussing this with me.

AARONHERTZMANN.COM

What is contemporary art?
I recently had some private conversations with artists that changed how I understand contemp...

Like · Reply · 4d

Aaron Hertzmann replied · 1 Reply

Alyosha Efros

I like the comparison to scientific communities. Another commonality is that, just like 90% of CVPR papers will turn out to be junk (either immediately or after a few years), so is 90% of contemporary art. This is normal and we shouldn't be disturbed by it. Just as I am happy to find a few CVPR papers that I like, I should feel happy if, at any contemporary art exhibition, I find 1-2 pieces that speak to me.

1

Like · Reply · 4d

Aaron Hertzmann

https://en.wikipedia.org/wiki/Sturgeon%27s_law

EN.WIKIPEDIA.ORG

Sturgeon's law - Wikipedia

2

Like · Reply · 4d

Like · Reply · 4d

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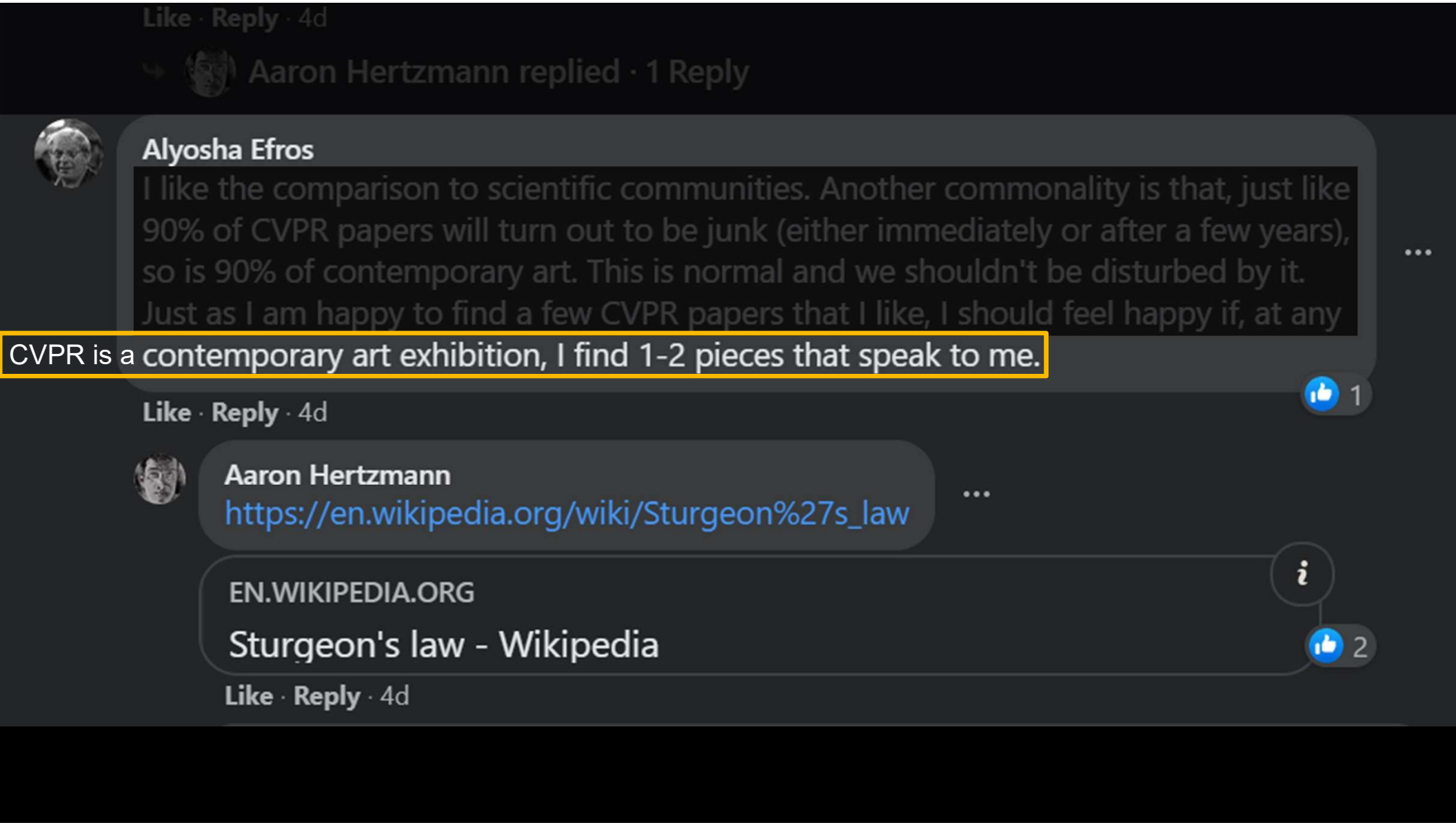
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Aaron Hertzmann
https://en.wikipedia.org/wiki/Sturgeon%27s_law
EN.WIKIPEDIA.ORG
Sturgeon's law - Wikipedia
2
Like · Reply · 4d

Sturgeon's law

From Wikipedia, the free encyclopedia

Sturgeon's law (or **Sturgeon's revelation**), is an adage that states that "ninety percent of everything is crap." The adage was coined by Theodore Sturgeon, an American science fiction author and critic. The adage was inspired by Sturgeon's observation while science fiction was often derided for its low quality by critics, the majority of examples of works in other fields could equally be seen to be of low quality, and science fiction was thus no different in that regard from other art.

Some make a distinction between the revelation ("ninety percent of everything is crap") and the law ("nothing is always absolutely so").

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CVPR is a contemporary art exhibition

Let’s stop pretending that all our 2000 CVPR papers convey good ideas

Garbage is a source for impact

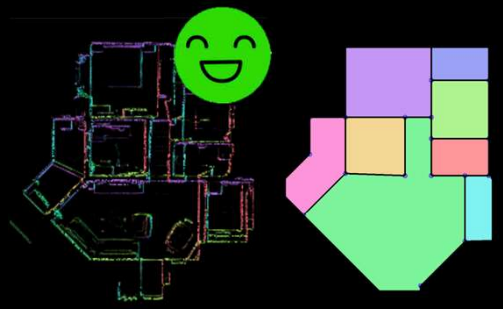
We are scared of reviewers…

Ice-age (no impact) → Revolution (impact)

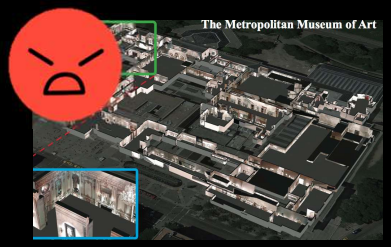
CVPR 2009

CVPR 2014

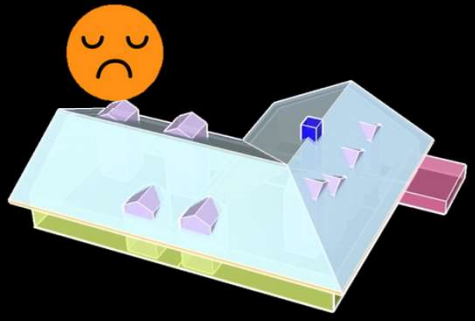
CVPR 2018/CVPR 2019



ECCV 2018/ICCV 2019



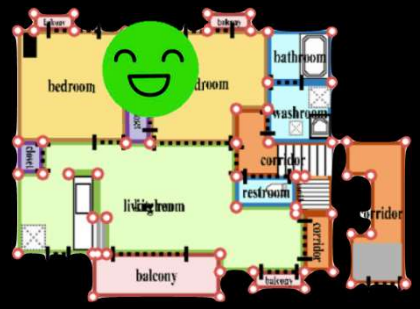
ECCV 2012



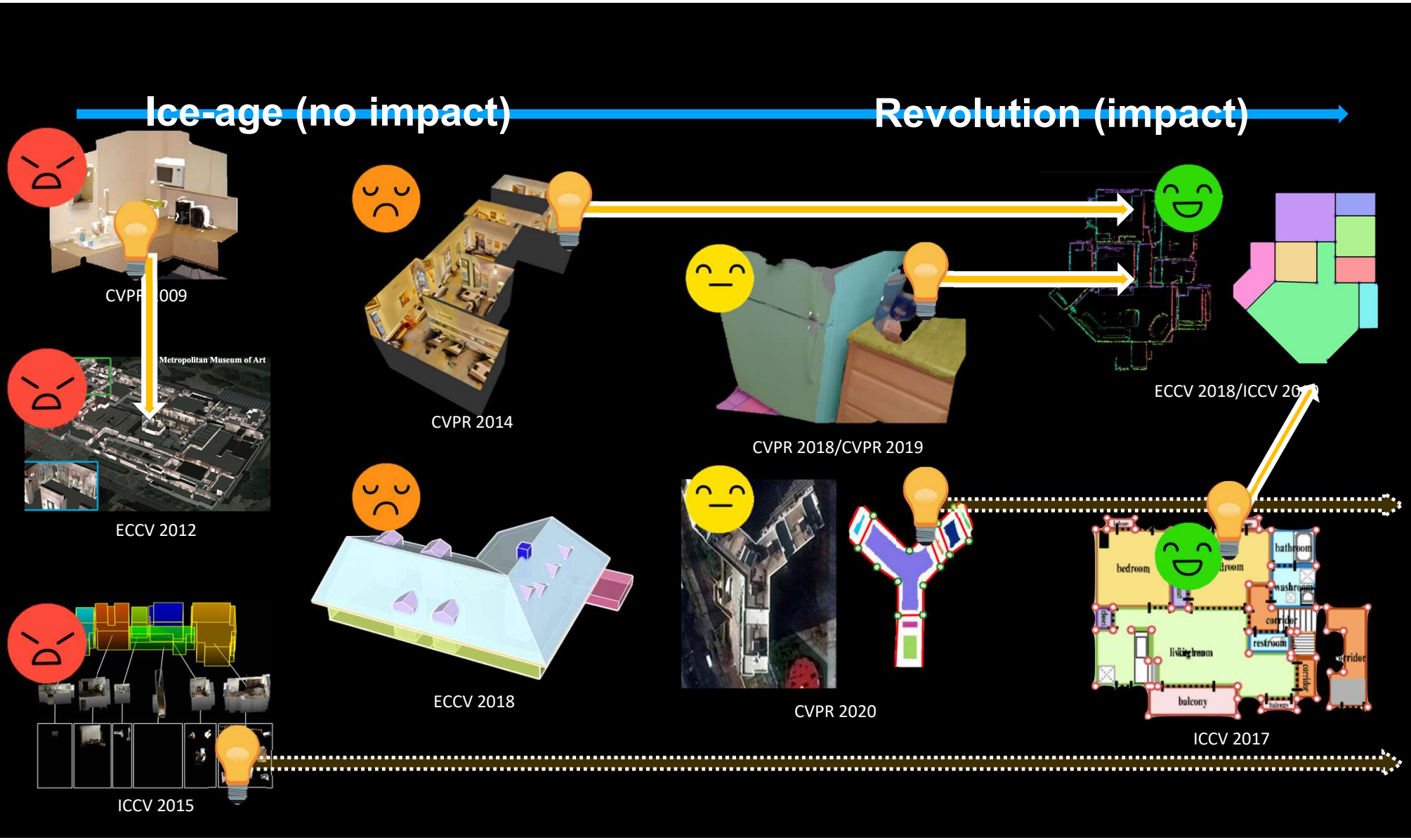
ECCV 2018

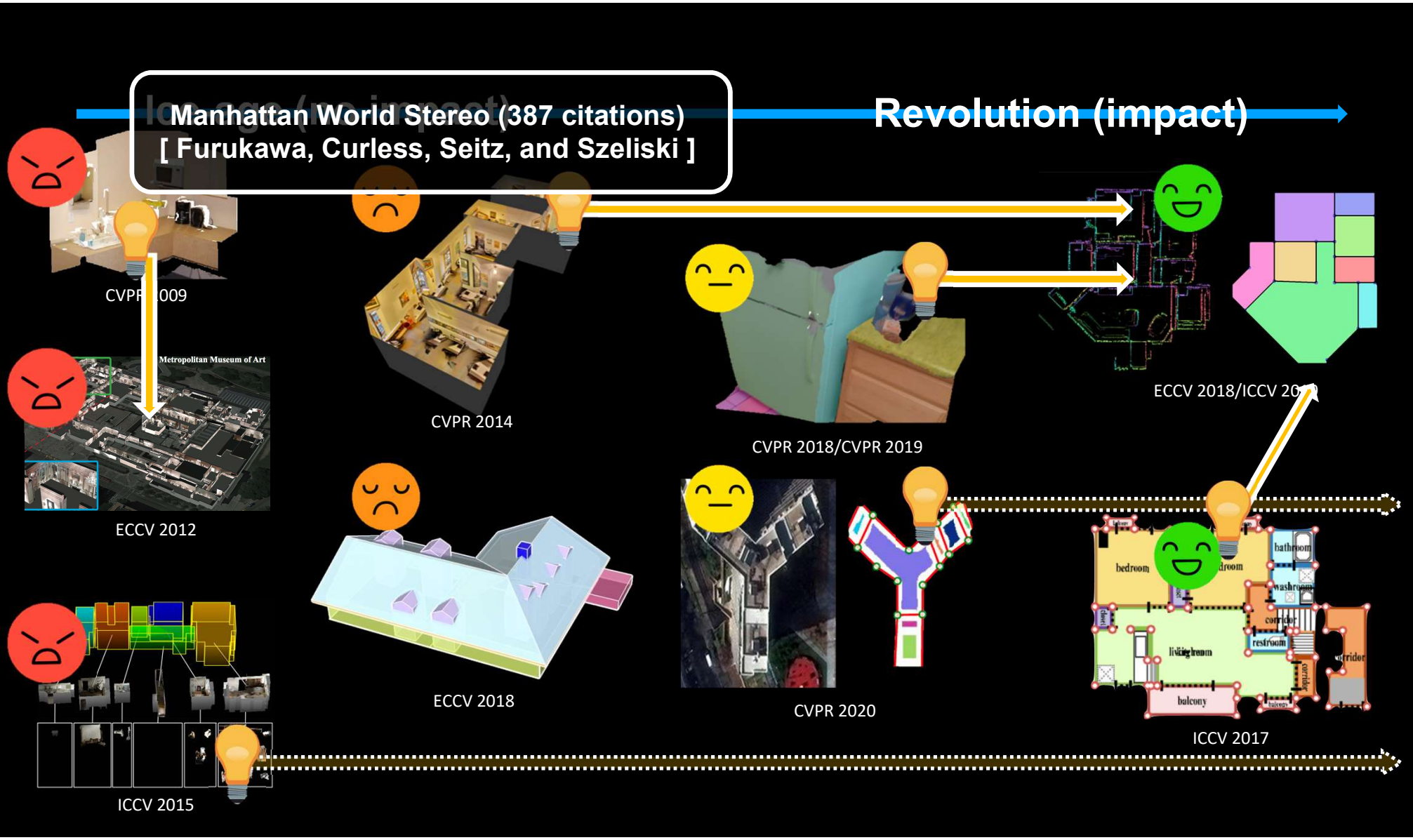
CVPR 2020

ICCV 2015



ICCV 2017


Ice-age (no impact)
Revolution (impact)
CVPR 2009
Metropolitan Museum of Art
ECCV 2012
ICCV 2015
CVPR 2014
ECCV 2018
CVPR 2018/CVPR 2019
CVPR 2020
ECCV 2018/ICCV 20
bedroom
bathroom
corridor
restroom
balcony
ICCV 2017


Manhattan World Stereo (387 citations)
[Furukawa, Curless, Seitz, and Szeliski]
Revolution (impact)
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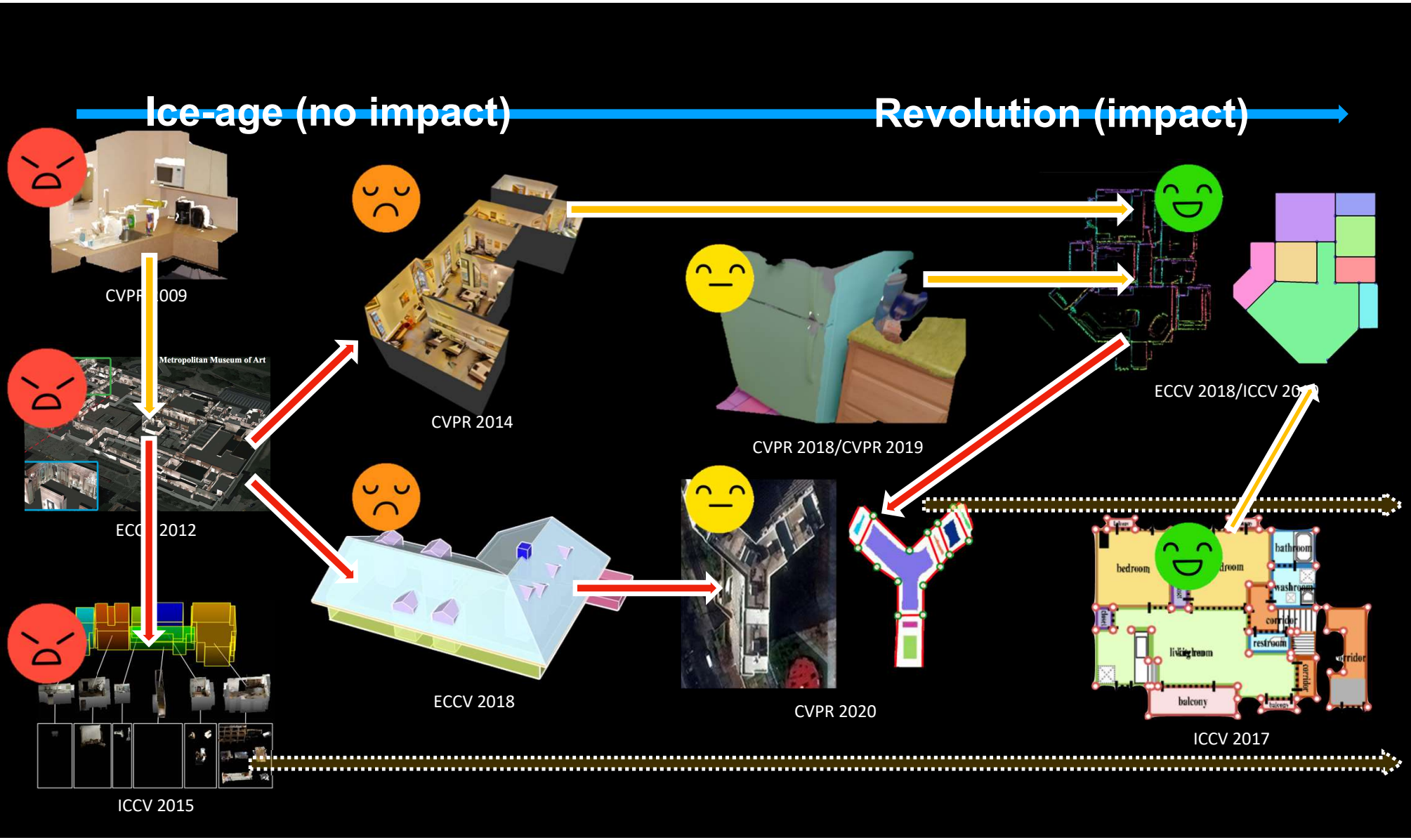
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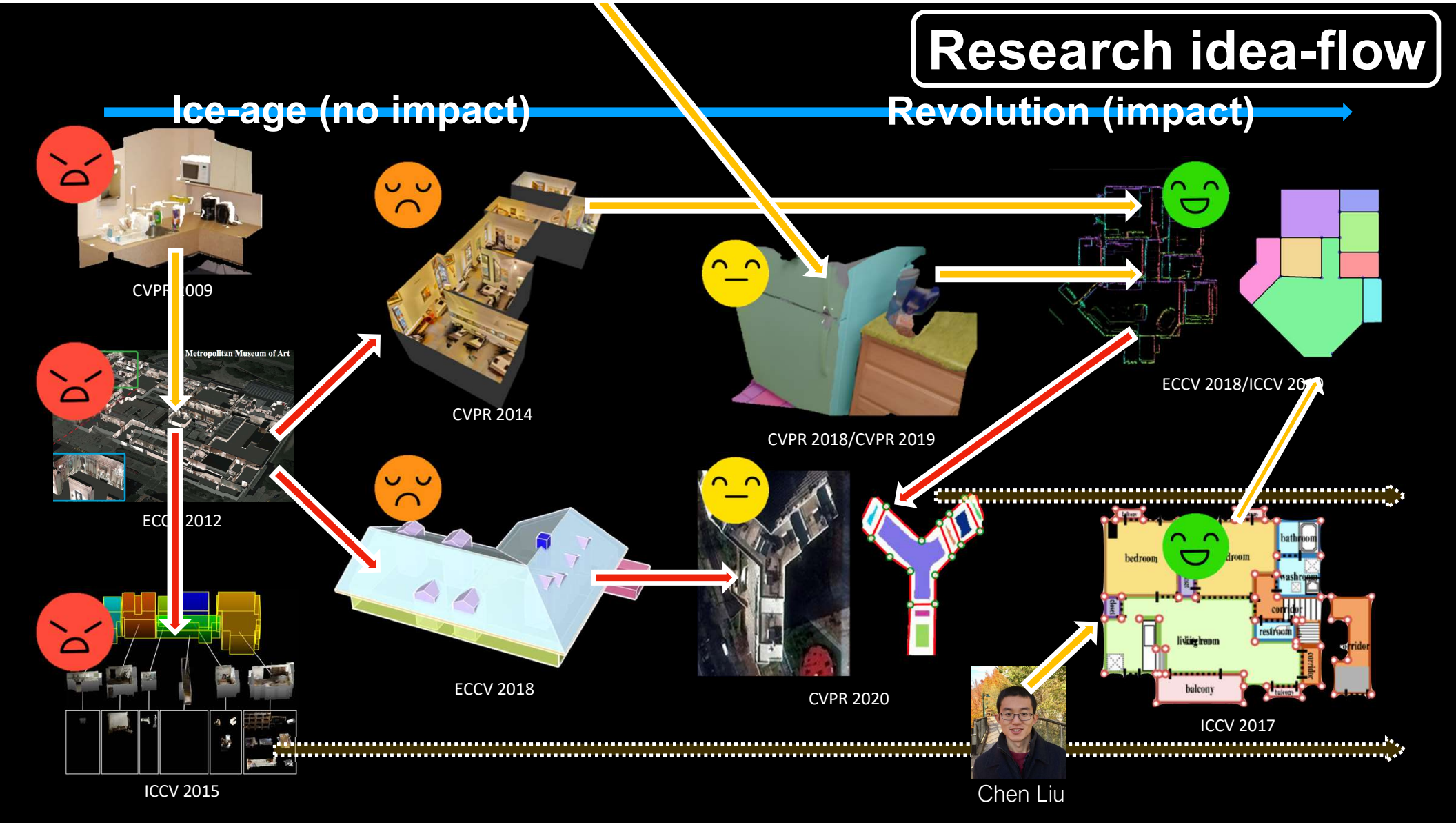
Research idea-flow
Ice-age (no impact)
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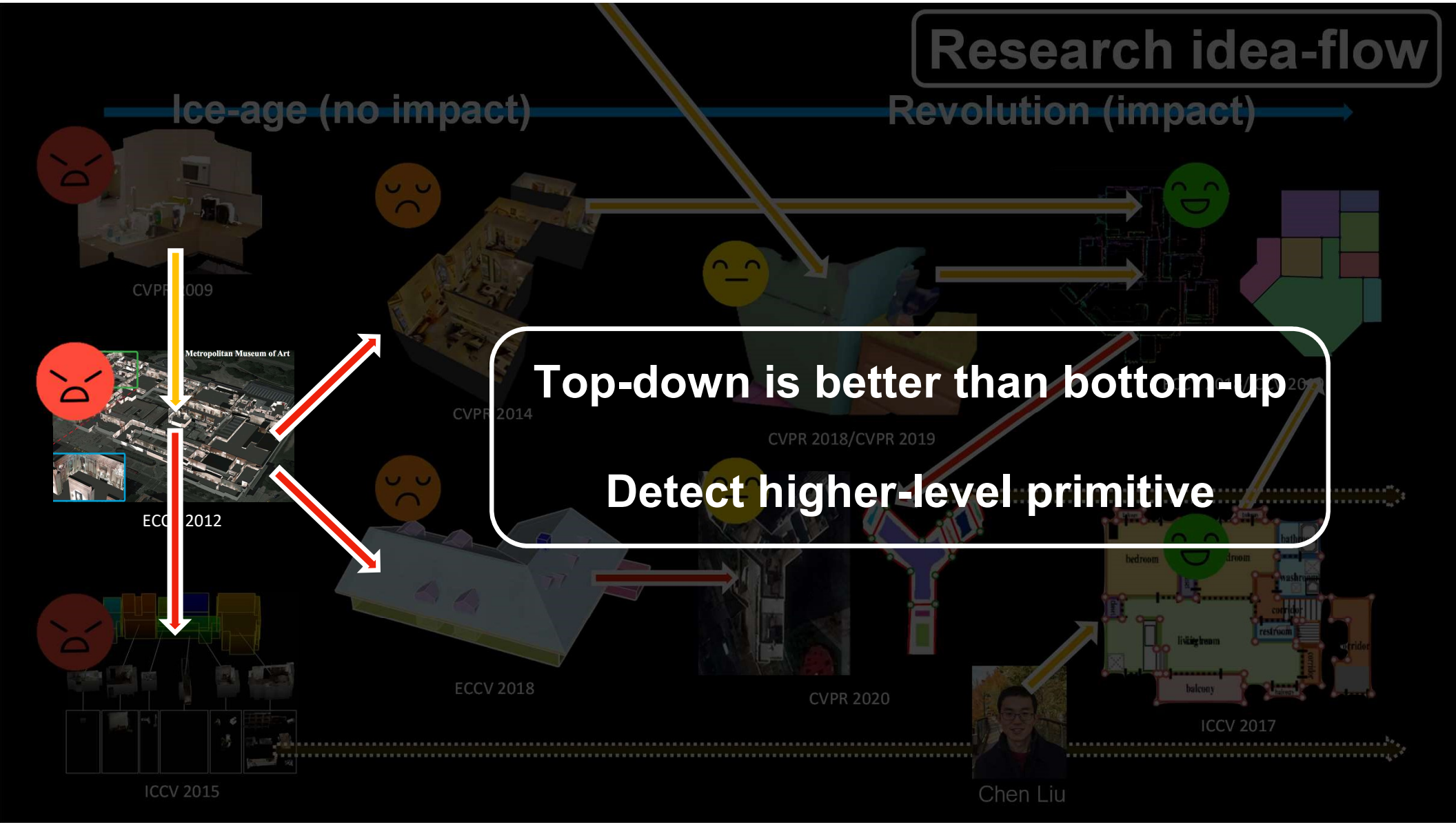
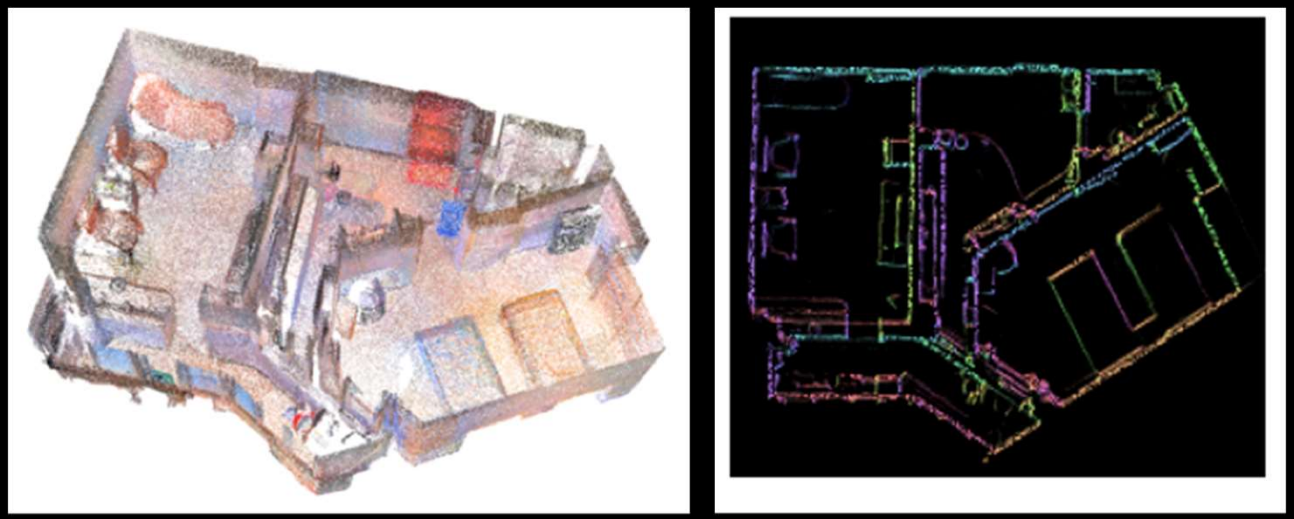
Chen Liu

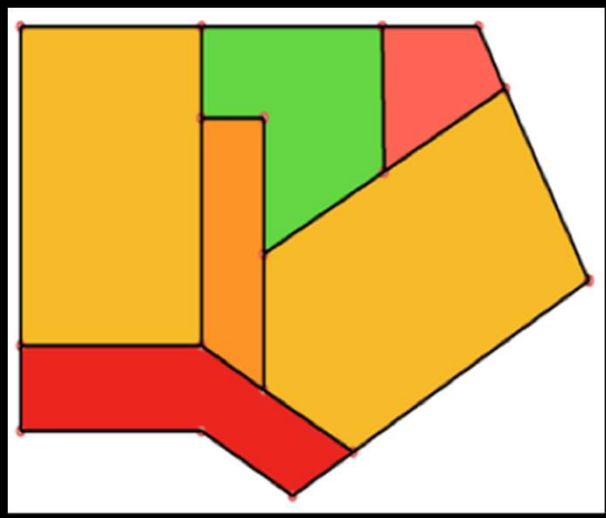

Research idea-flow
Ice-age (no impact)
Revolution (impact)
Metropolitan Museum of Art
Top-down is better than bottom-up
Detect higher-level primitive
CVPR 2018/CVPR 2019
ECCV 2018
CVPR 2020
ICCV 2017
ICCV 2015
Chen Liu

Detect higher-level primitives

3D points

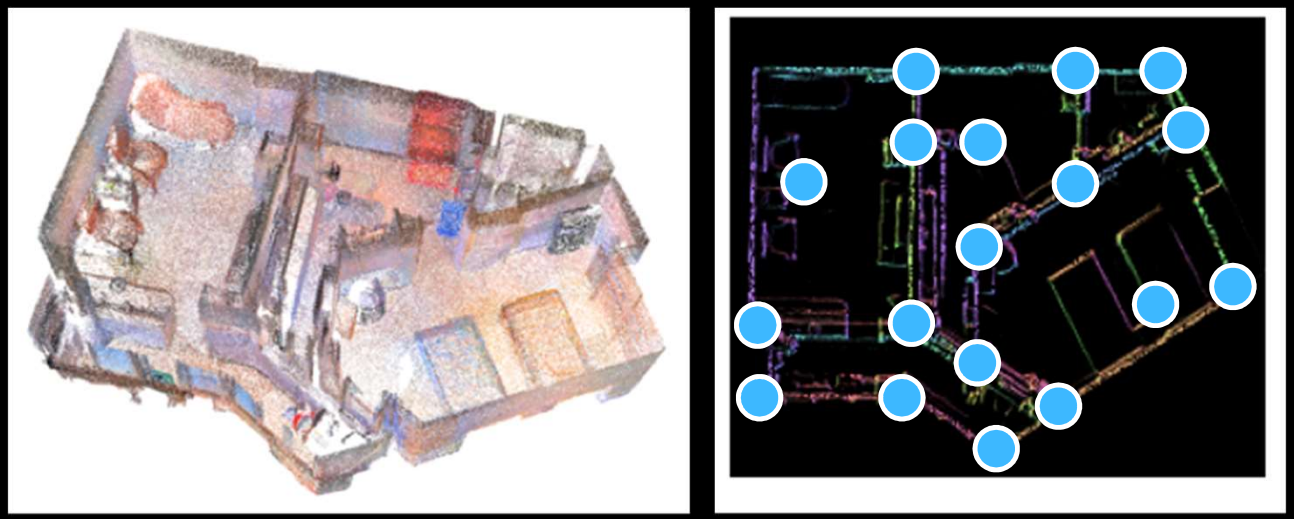


Floorplan



Bottom-up: Corner Detection

3D points



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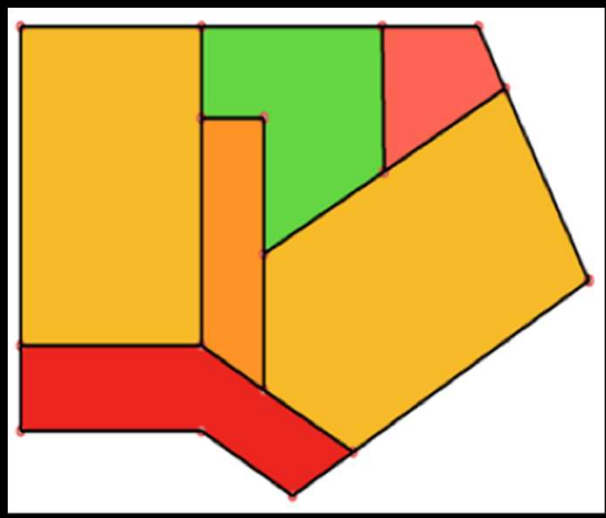

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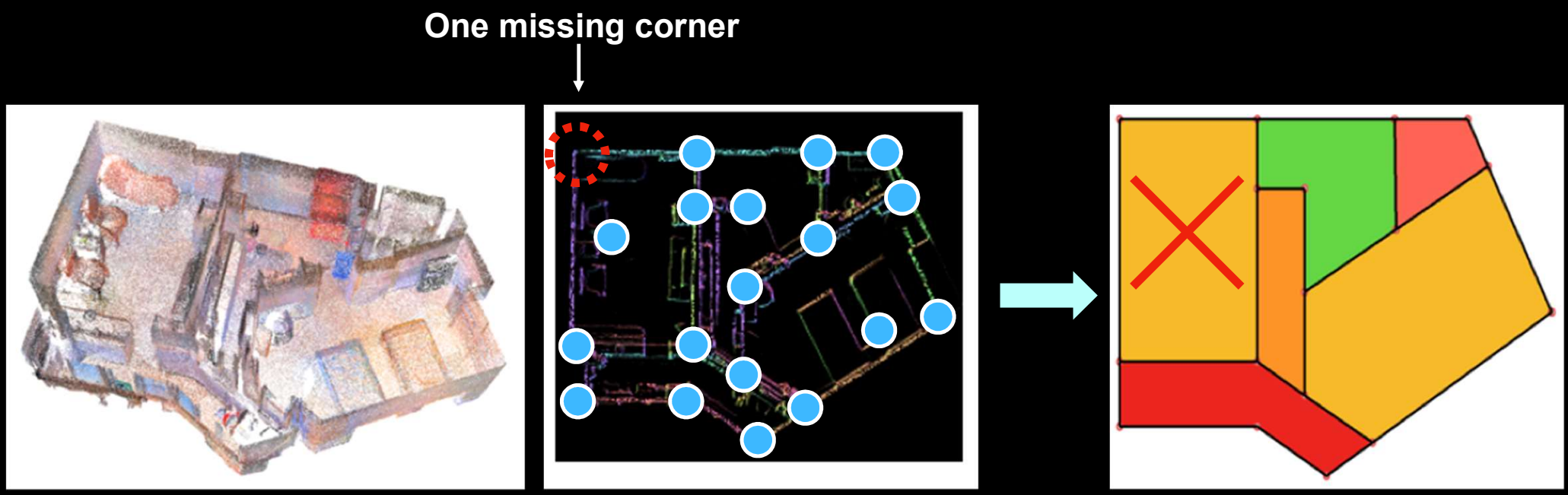

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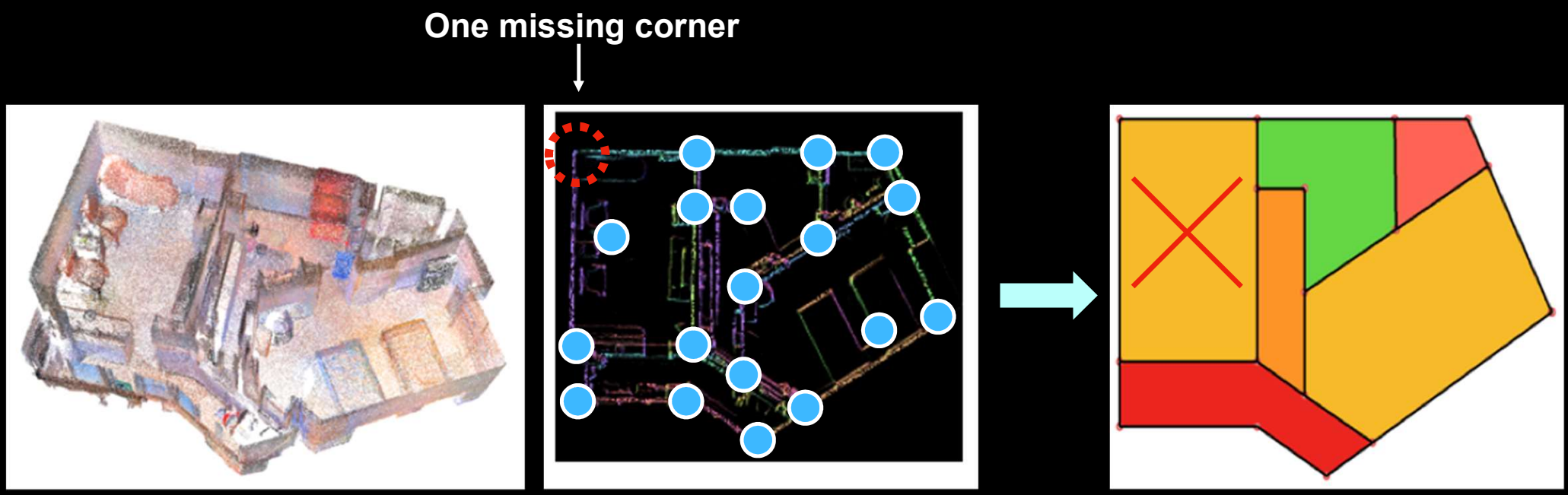
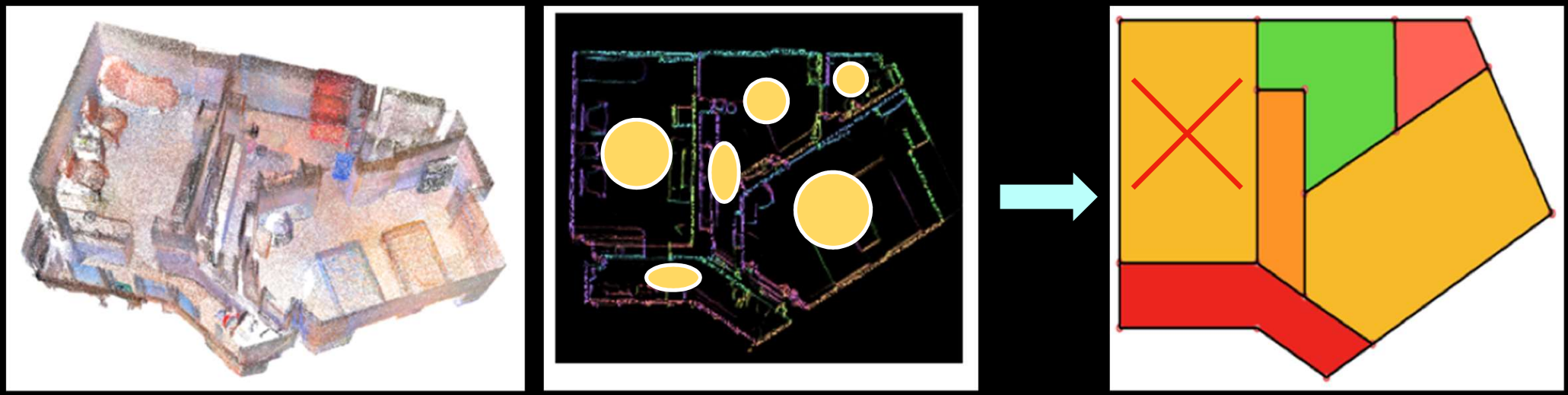
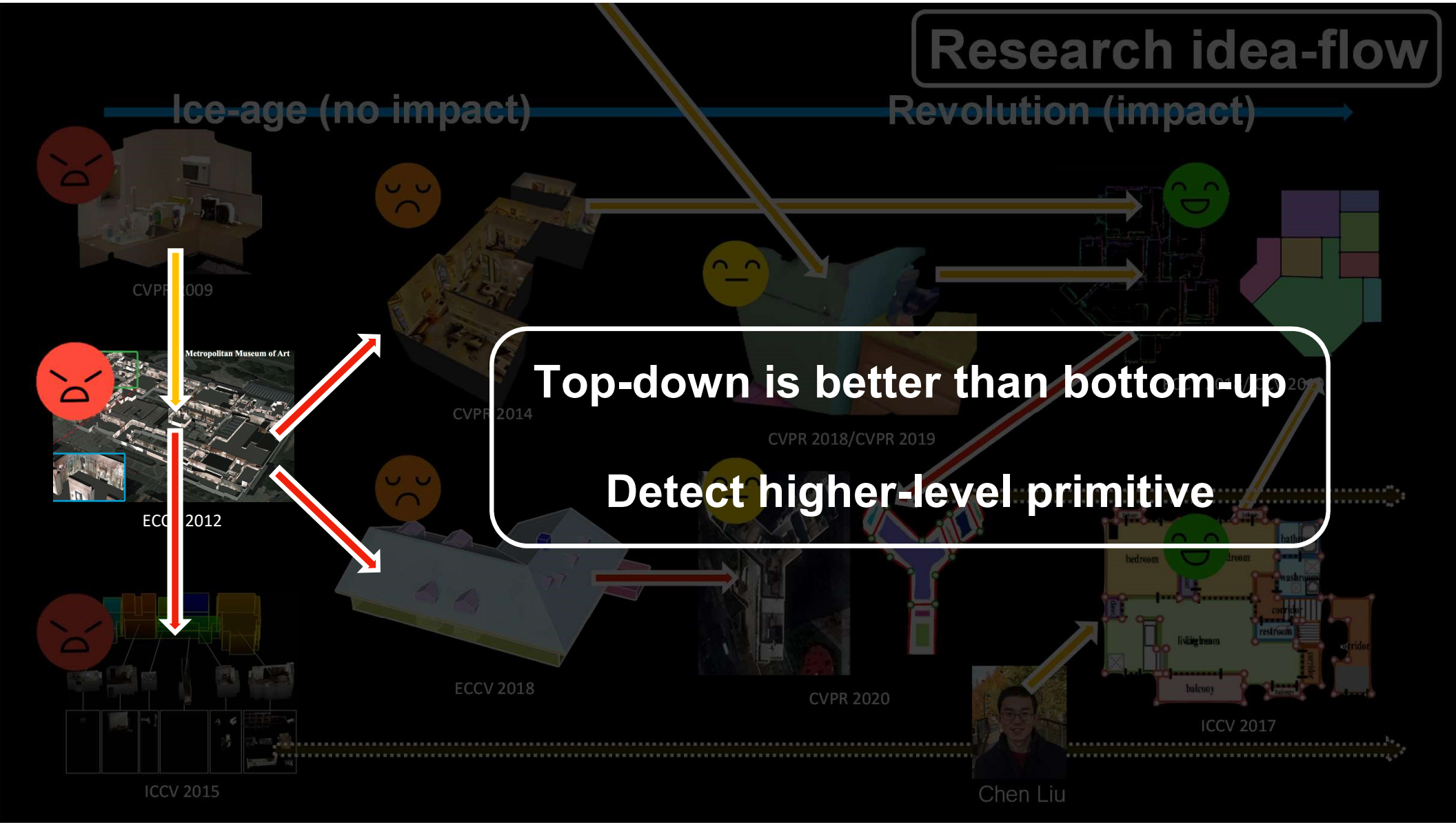


1. Cannot miss a single primitive.
2. Enumerate much more than necessary.
3. # of primitives to enumerate grow exponentially as the primitive DoF grows.

Top-down: Region Detection



Top-down: Region Detection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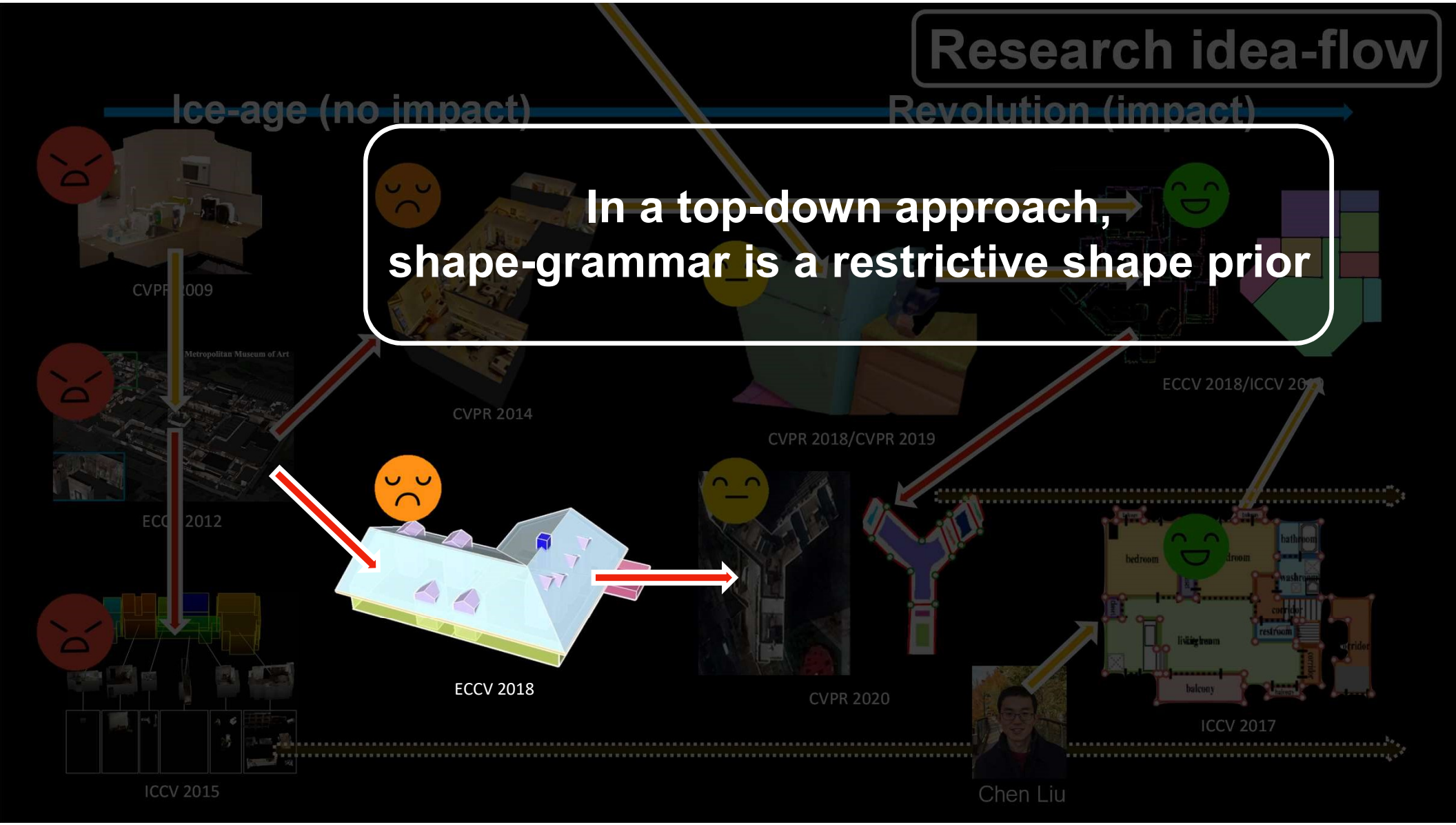
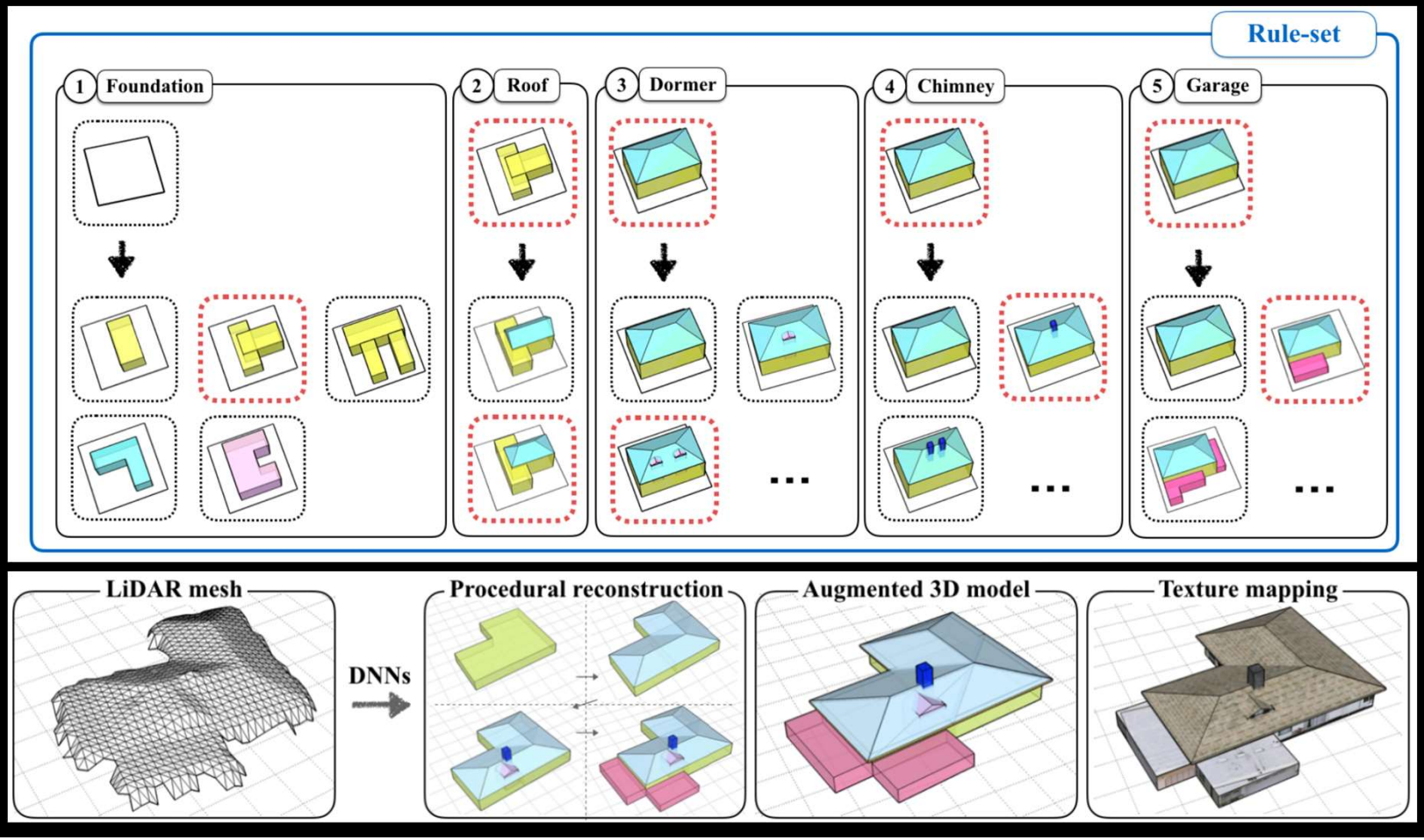
CVPR 2020
ICCV 2017
ICCV 2015
Chen Liu

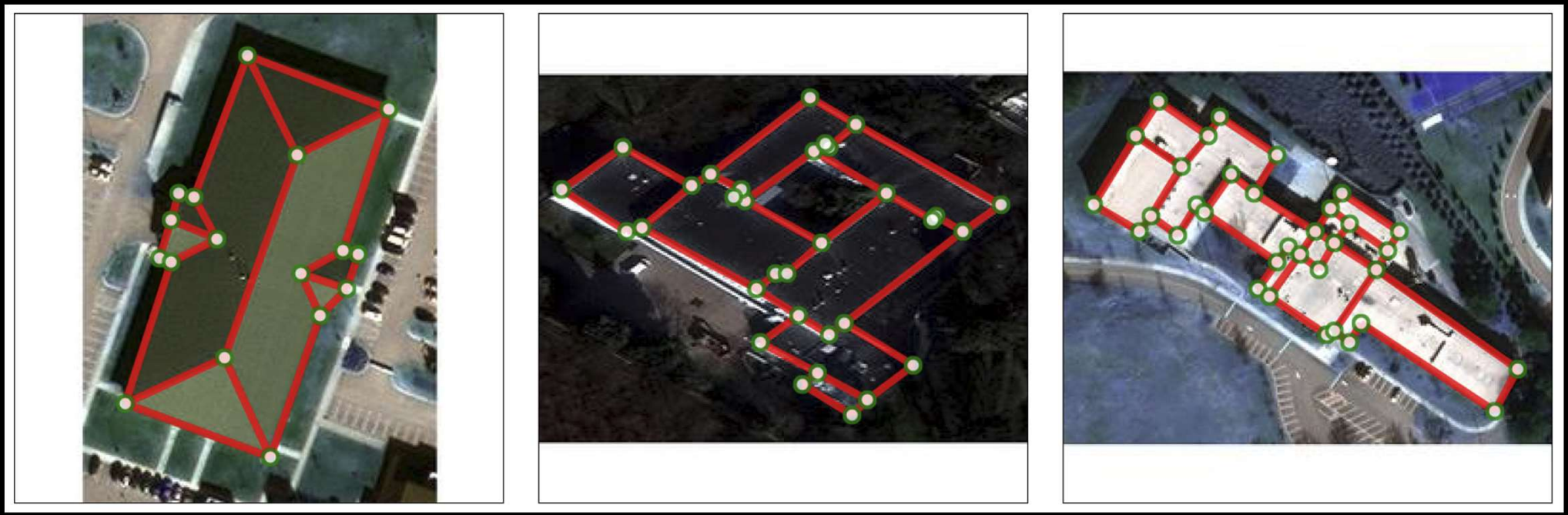

Research idea-flow
Ice-age (no impact)
Revolution (impact)
In a top-down approach,
shape-grammar is a restrictive shape prior
CVPR 2014
CVPR 2018/CVPR 2019
ECCV 2018/ICCV 20
ECCV 2018
CVPR 2020
ICCV 2017
ICCV 2015
Chen Liu

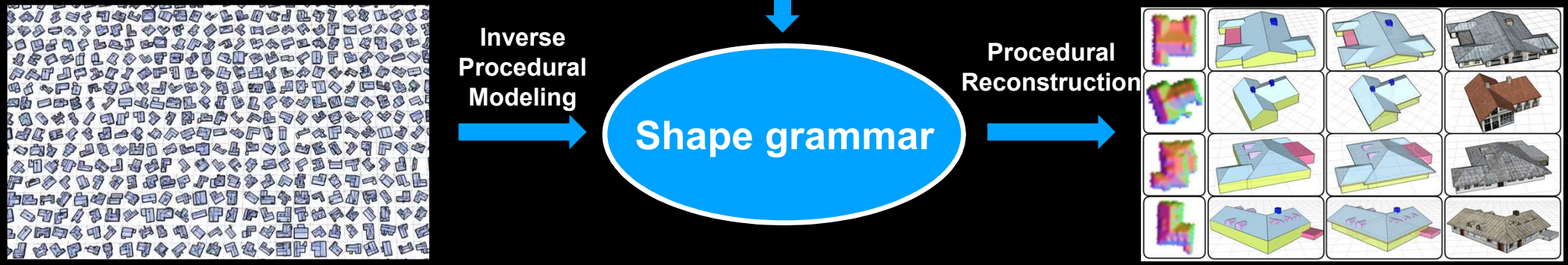
Shape grammar as a shape prior

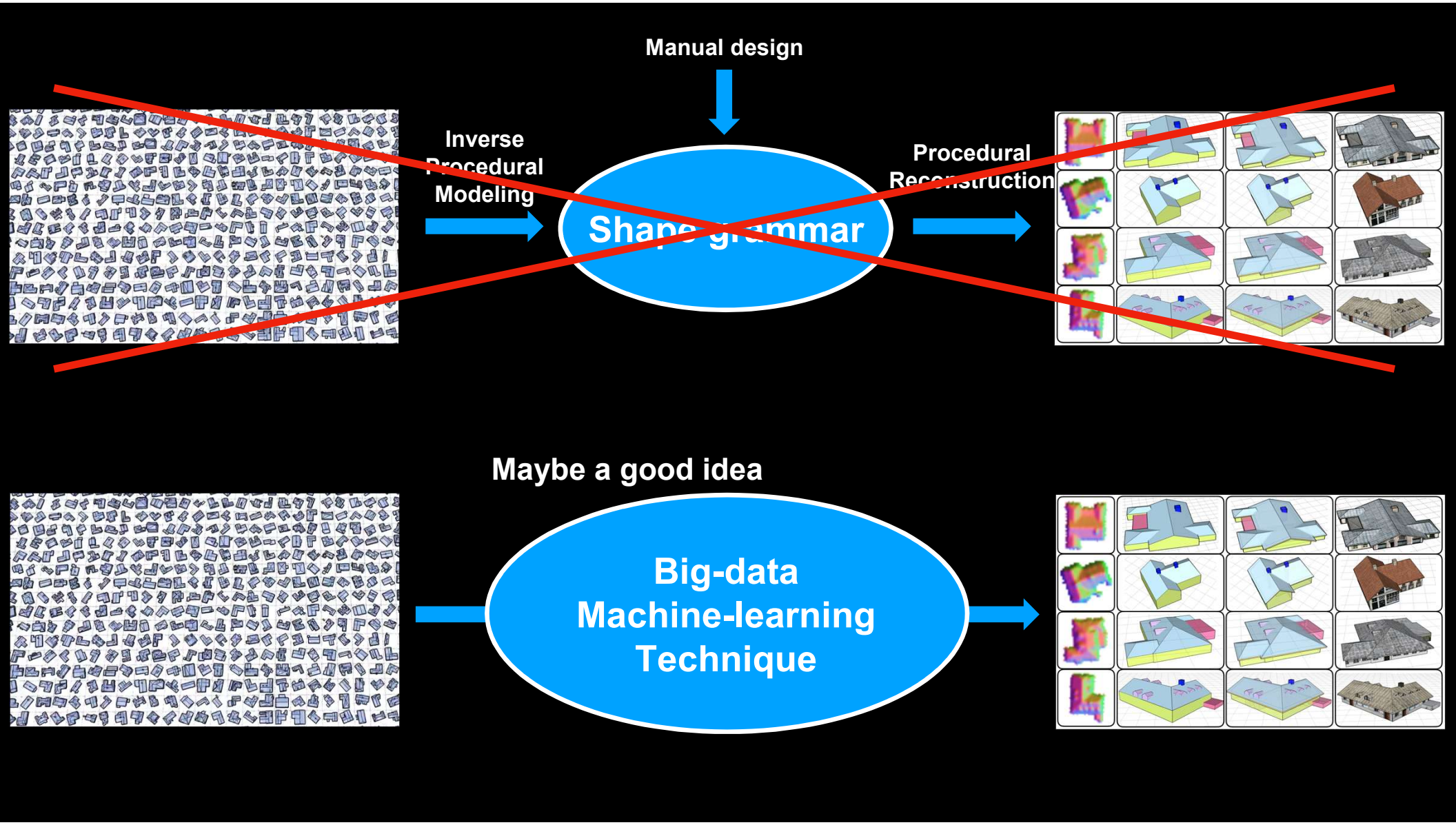


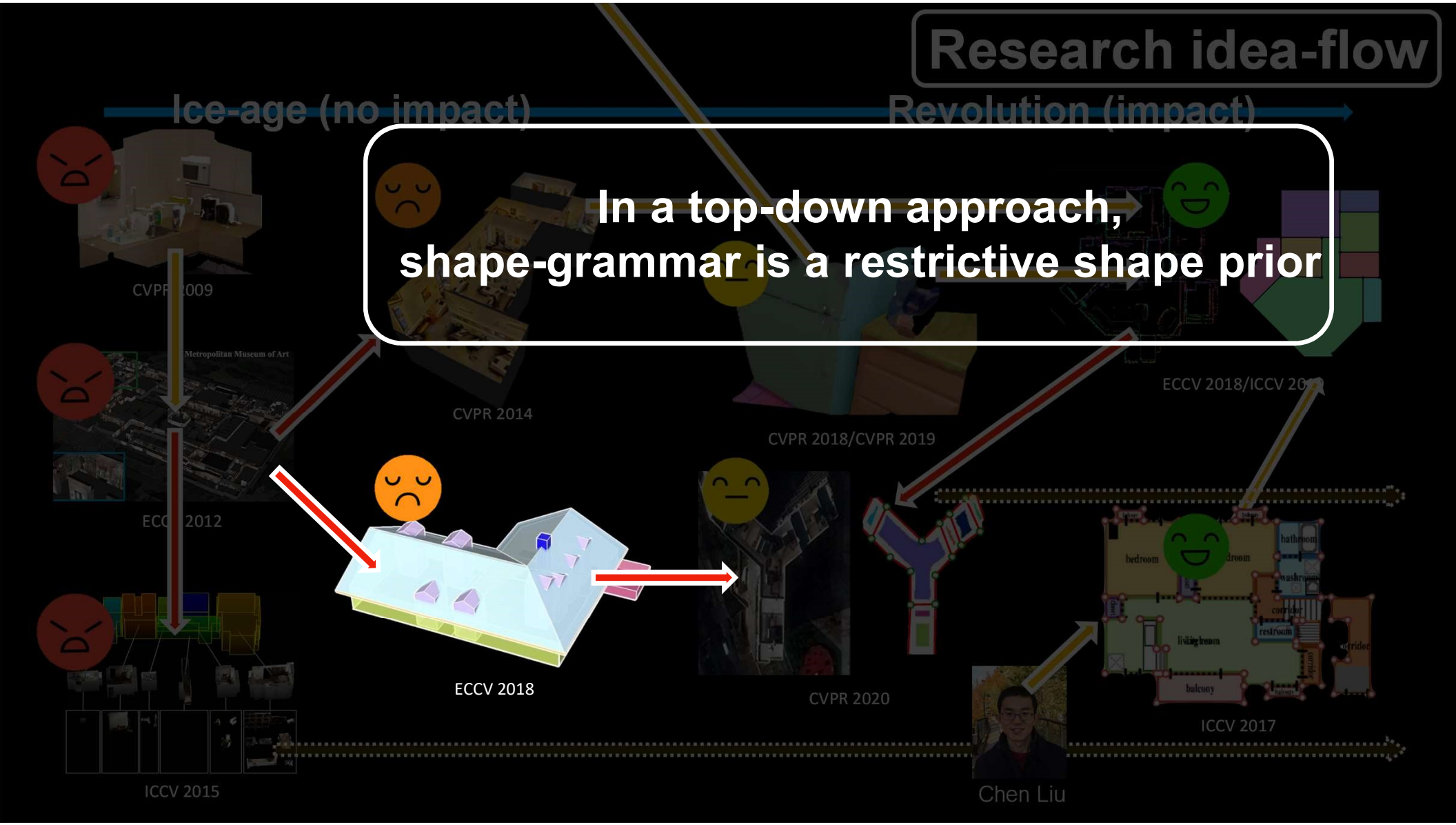
Dyer Road
Google Earth

Grammar cannot model complex buildings




Manual design
Inverse
Procedural
Modeling
Shape grammar
Procedural
Reconstruction


Manual design
Inverse Procedural Modeling
Shape grammar
Procedural Reconstruction
Maybe a good idea
Big-data Machine-learning Technique


Research idea-flow
Ice-age (no impact)
Revolution (impact)
In a top-down approach,
shape-grammar is a restrictive shape prior
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CVPR 2018/CVPR 2019
ECCV 2018
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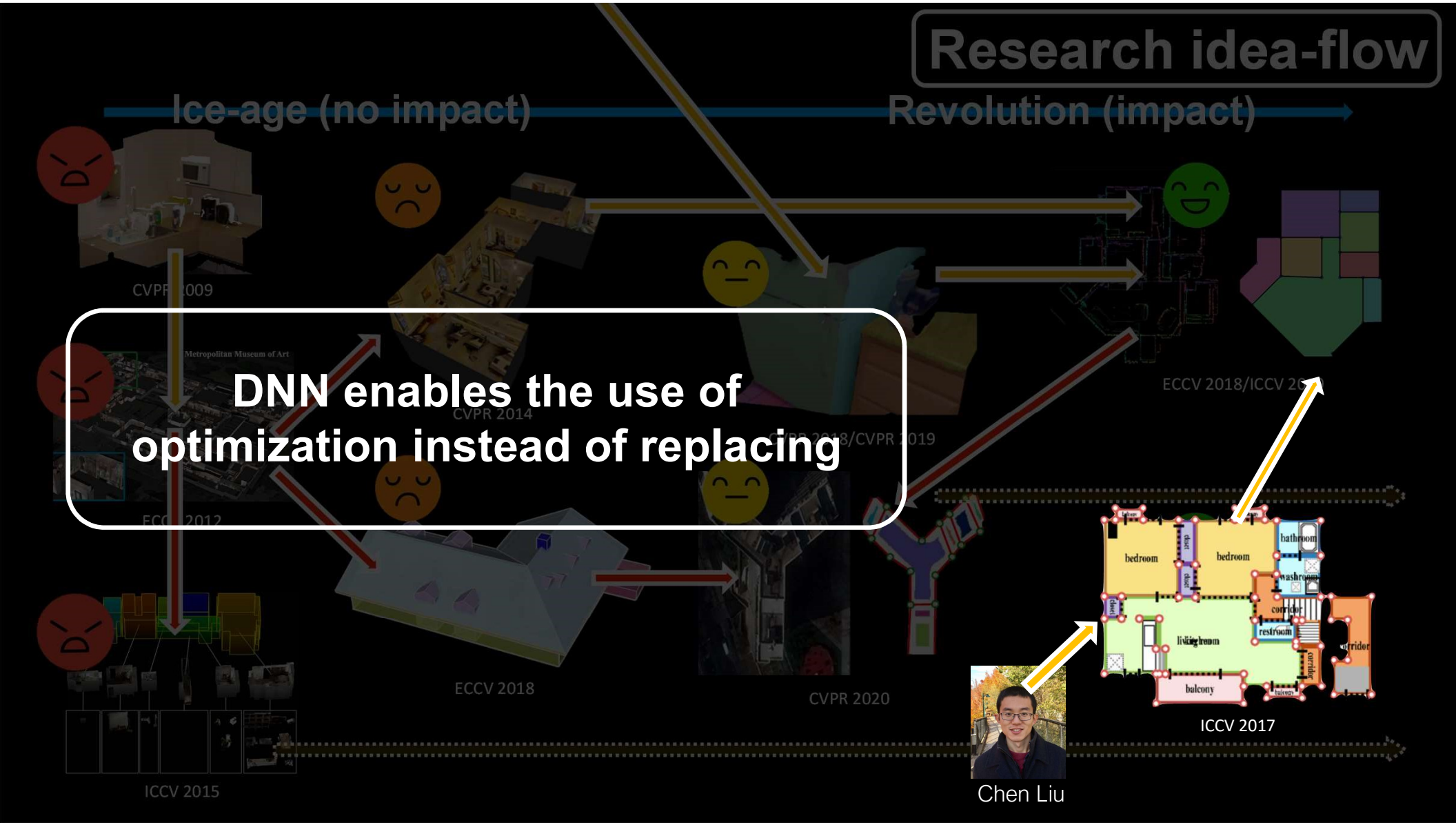
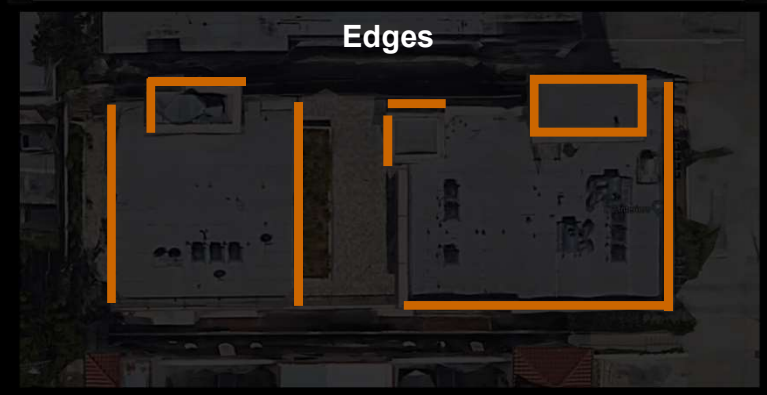

Research idea-flow
Ice-age (no impact)
Revolution (impact)
DNN enables the use of optimization instead of replacing
CVPR 2009
Metropolitan Museum of Art
CVPR 2014
ECCV 2012
ECCV 2018/ICCV 2019
ECCV 2018
CVPR 2020
ICCV 2015
bedroom
bedroom
bathroom
corridor
restroom
balcony
ICCV 2017
Chen Liu

Outdoor Architecture Vectorization

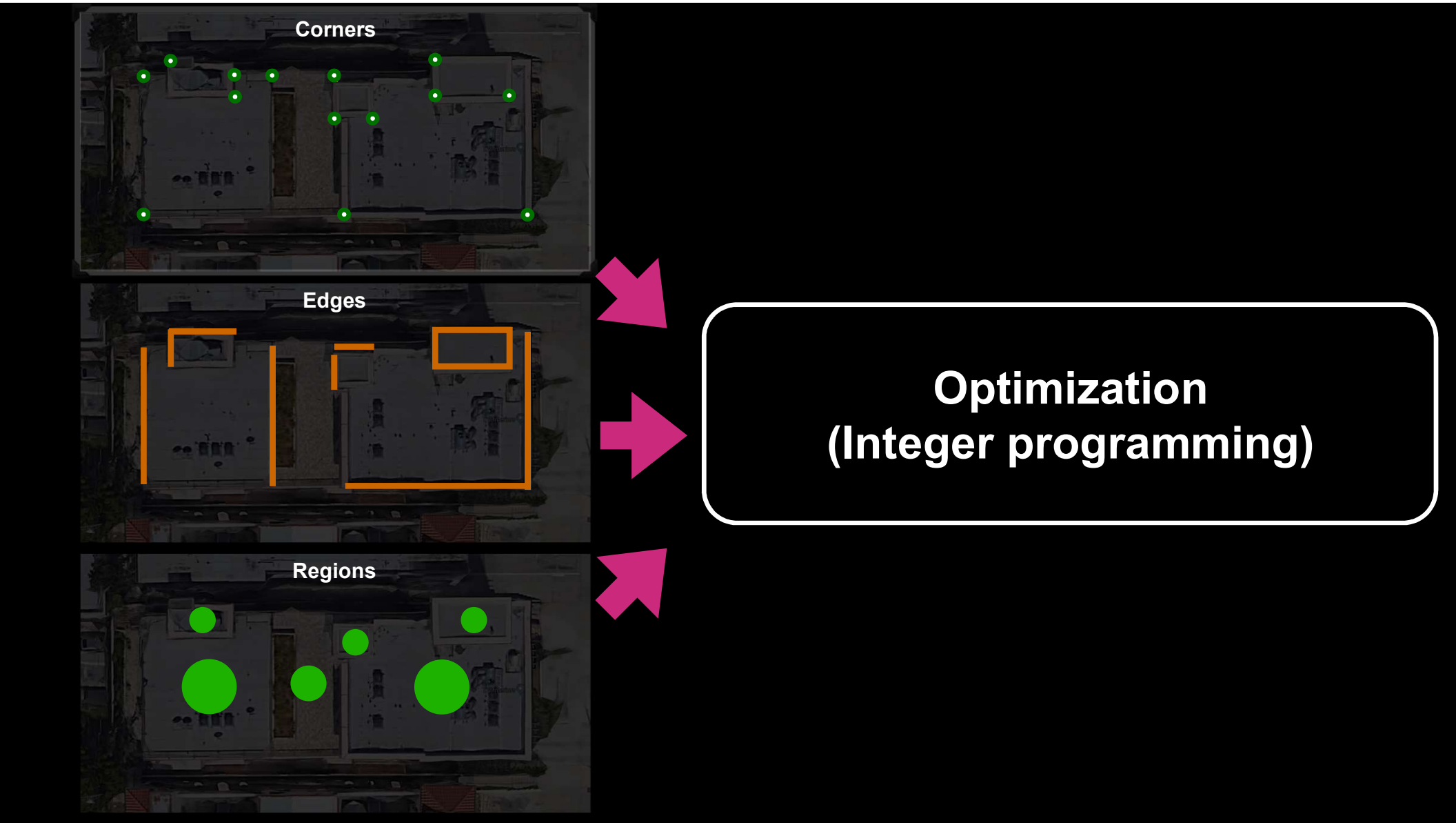
Google Maps - satellite (2D)

CAD model / Architect drawing

Corners


Edges

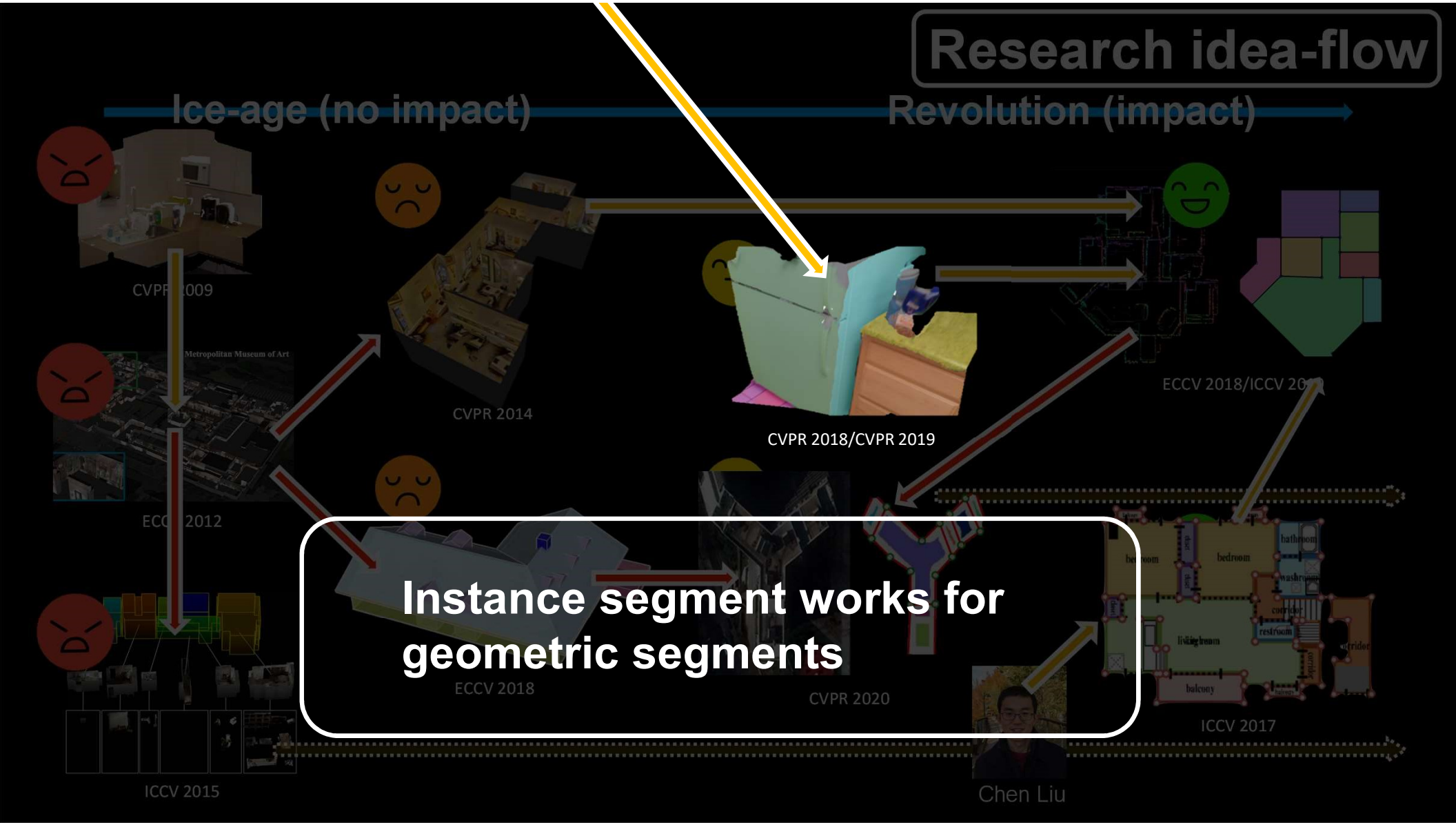
Regions

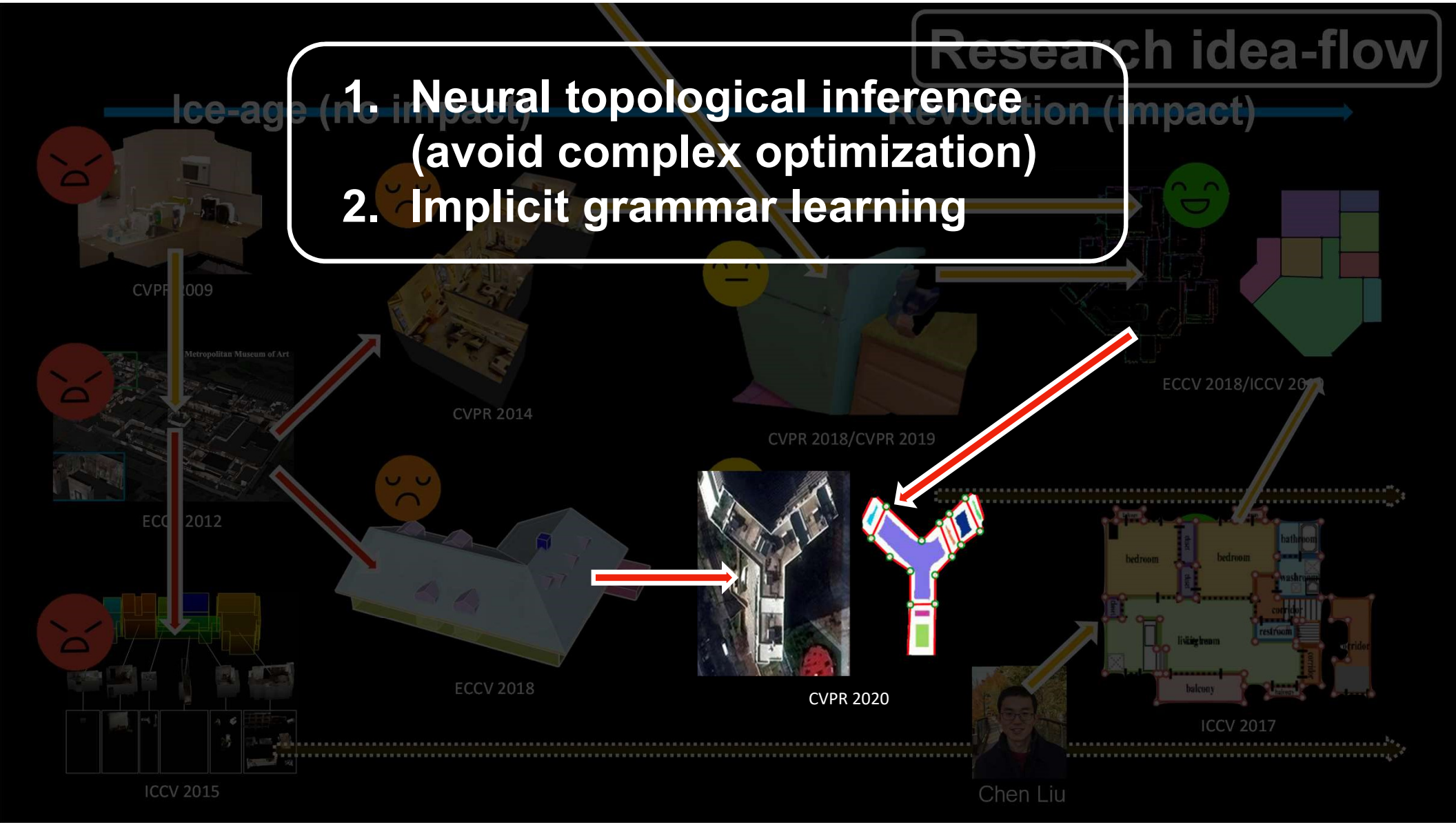

Corners
Edges
Regions
Optimization
(Integer programming)

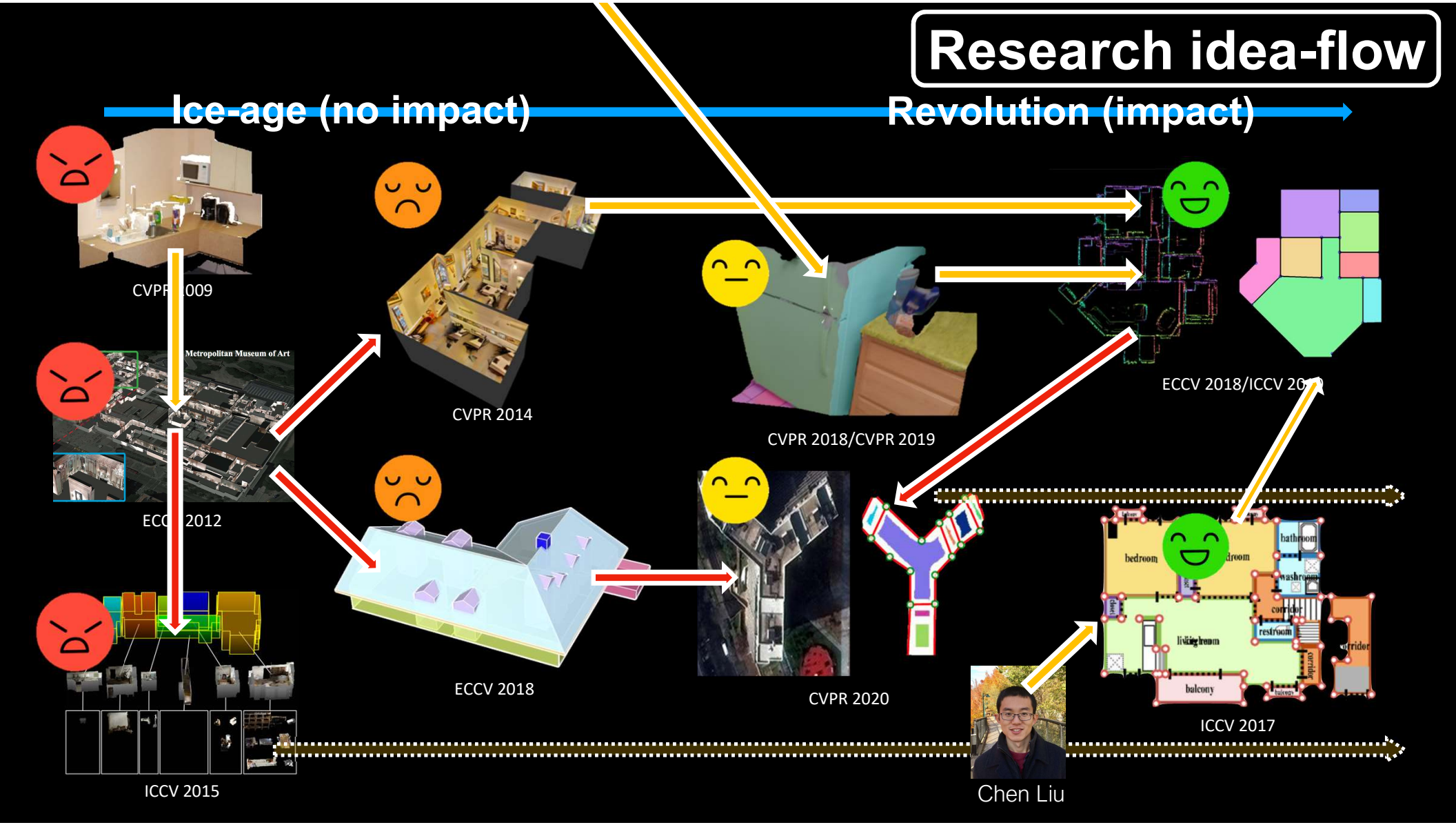
DNN enables optimization instead of replacing

- DNN shrinks candidate pool
- DNN make energy landscape easy

	Scalability	Inference power
MRF	A few million vars	Pairwise Mostly submodular
IP	A few hundred vars	Higher-order Non-submodular


Research idea-flow
Ice-age (no impact)
Revolution (impact)
CVPR 2009
CVPR 2014
CVPR 2018/CVPR 2019
ECCV 2018/ICCV 20
ECCV 2012
Instance segment works for geometric segments
ECCV 2018
CVPR 2020
ICCV 2017
ICCV 2015
Chen Liu


Research idea-flow
Ice-age (no impact)
Revolution (impact)
1. Neural topological inference
(avoid complex optimization)
2. Implicit grammar learning
CVPR 2009
Metropolitan Museum of Art
ECCV 2012
ICCV 2015
CVPR 2014
ECCV 2018
CVPR 2018/CVPR 2019
CVPR 2020
ECCV 2018/ICCV 20
bedroom
bedroom
bathroom
restroom
balcony
ICCV 2017
Chen Liu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CVPR 2009
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Chen Liu

Research idea-flow

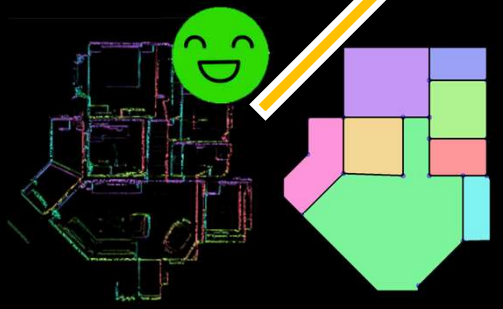
Ice-age (no impact)

Revolution (impact)

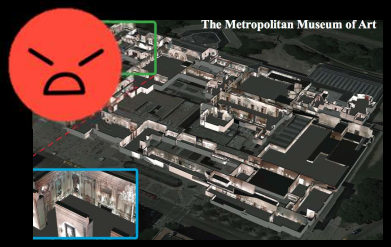
CVPR 2009

CVPR 2014

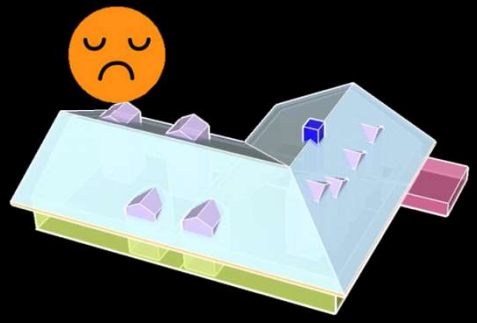
CVPR 2018/CVPR 2019



ECCV 2018/ICCV 2019

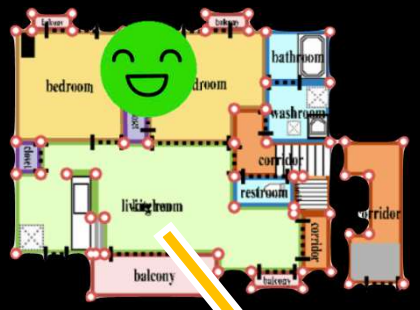


ECCV 2012



ECCV 2018

CVPR 2020



ICCV 20

ICCV 2015

Research idea-flow

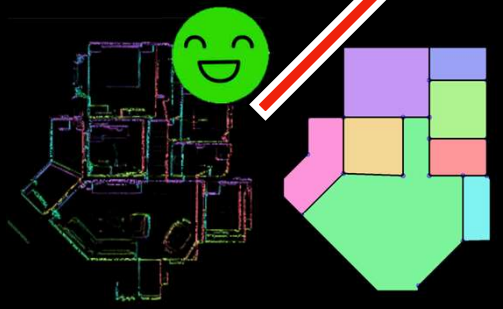
Ice-age (no impact)

Revolution (impact)

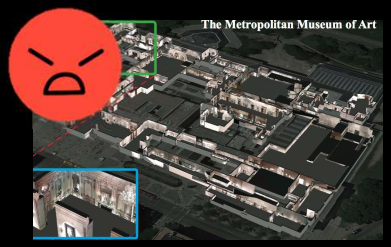
CVPR 2009

CVPR 2014

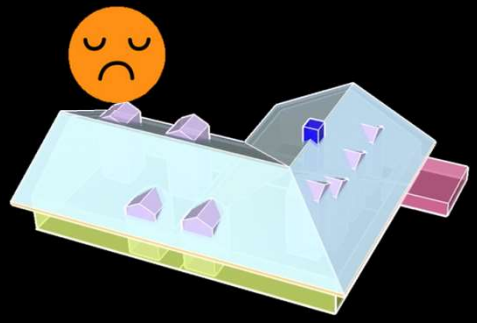
CVPR 2018/CVPR 2019



ECCV 2018/ICCV 2019

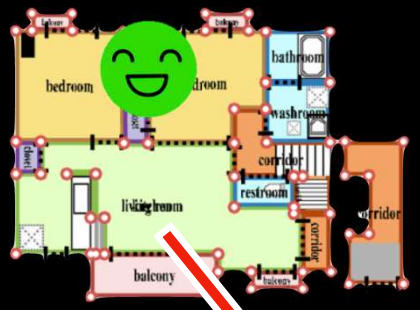


ECCV 2012



ECCV 2018

CVPR 2020



ICCV 20

ICCV 2015

Garbage ideas lead to impact
Find your masterpiece at CVPR