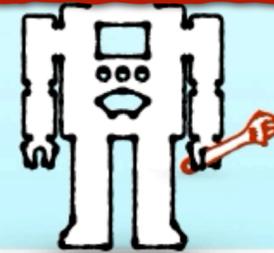
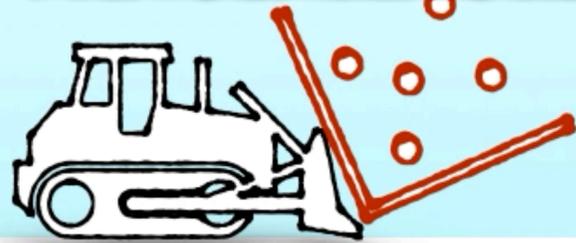


Is AI Ready for the Building Industry?

(and vice-versa)

Concluding Remarks

August 26th, 8-9AM (PT)



Scan me!



1st AI4AEC Colloquium

Stanford | Aug 19th-20th-26th | 2020



#AIAEC
@AI4_AEC

Session Summary

How can Computer Vision and Mixed Reality help AEC?

Keynote Talk | Marc Pollefeys

Development of Computer Vision along the 3 Waves of Computing

1. Computers can construct visual and semantic 3D models from images/videos using AI algorithms.

2. Mobile devices now provide user-friendly on-the-go apps and expand accessibility.

3. Mixed reality and connected devices will enable interaction between physical and digital worlds.

CURRENT

EMERGING

ENVISIONED

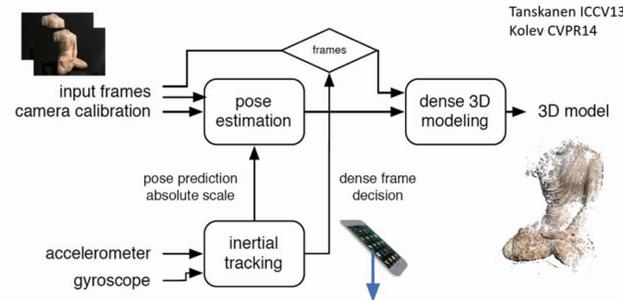
Building Rome on a cloudless day



(Frahm et al. ECCV 2010)

2.8M images processed in 24h on single PC
 >300k images registered
 >60k 3D models
 for comparison: Agarwal'09
 150k images processed in 24h on 64x PCs in cloud

Turning mobile phones in 3D scanners

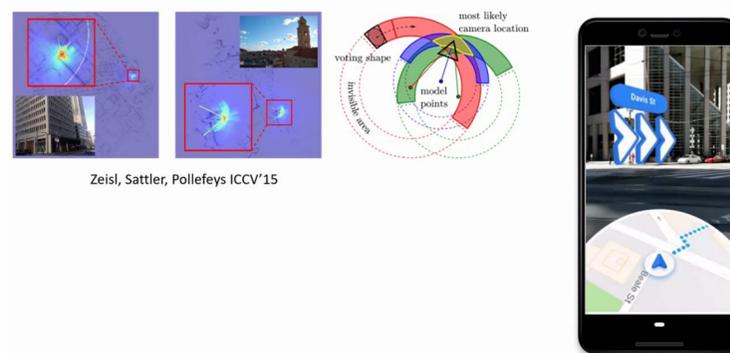


Consensus Maximization for Semantic Region Correspondences

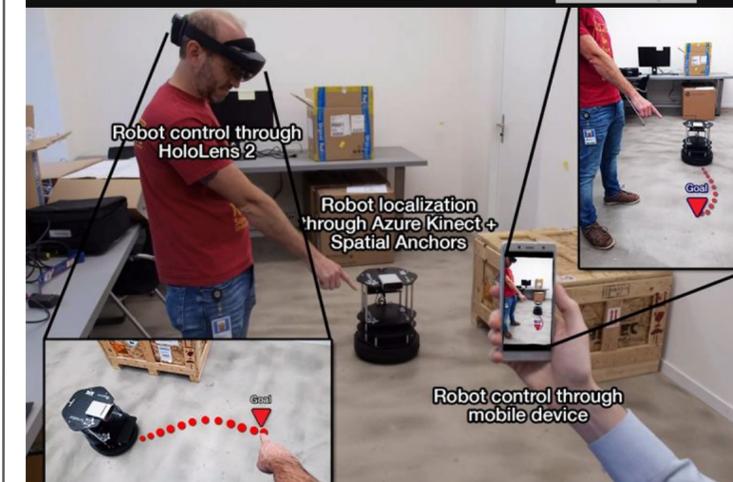
Speciale et al CVPR18



Camera Pose Voting for Large-Scale Image-Based Localization



HoloLens2 Hand-tracking



Toward Ambient Intelligence in AI-Assisted Healthcare Spaces

AI4Health Session | Serena Yeung

“Medical error in healthcare execution results in 251,000 deaths per year. AI can change this.”

Infrastructure Enabling AI in Healthcare

- Sensor arrays (thermal & depth) to preserve privacy of individuals in data
- Localized data analysis and management infrastructure
- Reinforcement learning frameworks for efficient action recognition

AI Stage	AI Broad Application	AI Implementation
Current	Scaling what humans can't practically do	Hand-Washing monitoring
Emerging	Automating what humans don't want to do	Medical Scribe Automation
Envisioned	Performing high-skill tasks at expert or "superhuman" level	Analysis of Healthcare Procedures in Real Time

Differentiable Architects

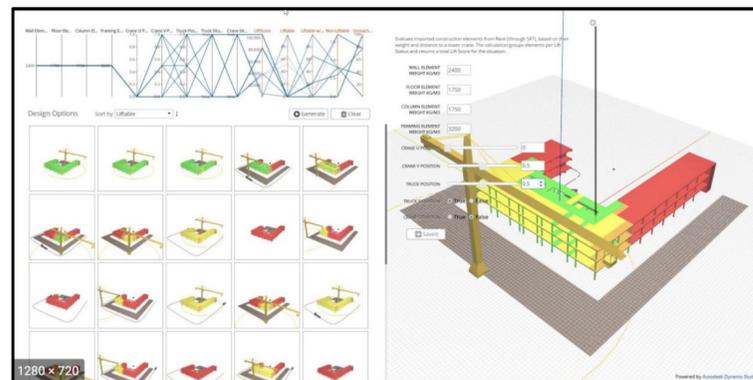
AI4AEC Session | Alberto Tono & Jiajun Wu

- Main themes**
- Best design decision at the conceptual design phase, as it has the most impact on building performance
 - To combine a computer's ability with knowledge of an architect, which grows exponentially with time.

AI Stage	AI Broad application	Key enabling methods
Current	Optimization	Project fractal (search algorithms)
Emerging	Automation, Simplification	GAN, House GAN, 3D GAN etc.
Envisioned	Democratization	GAN dissection

Existing challenges:

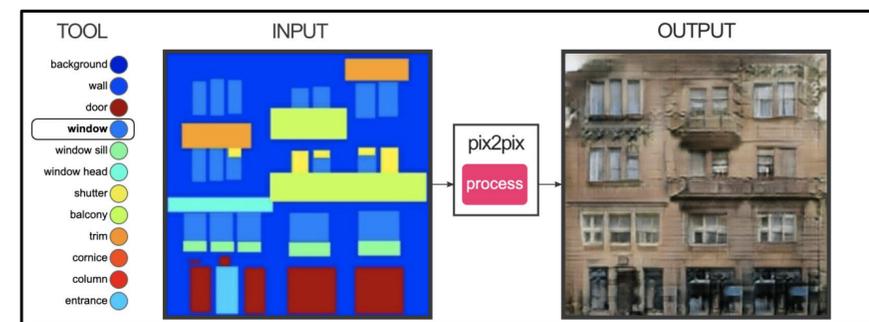
1. Mode Collapse as GAN remembers 'common' things
2. Limited creativity due to data dependence
3. To improve trust in algorithms and remove biases



Project Fractal



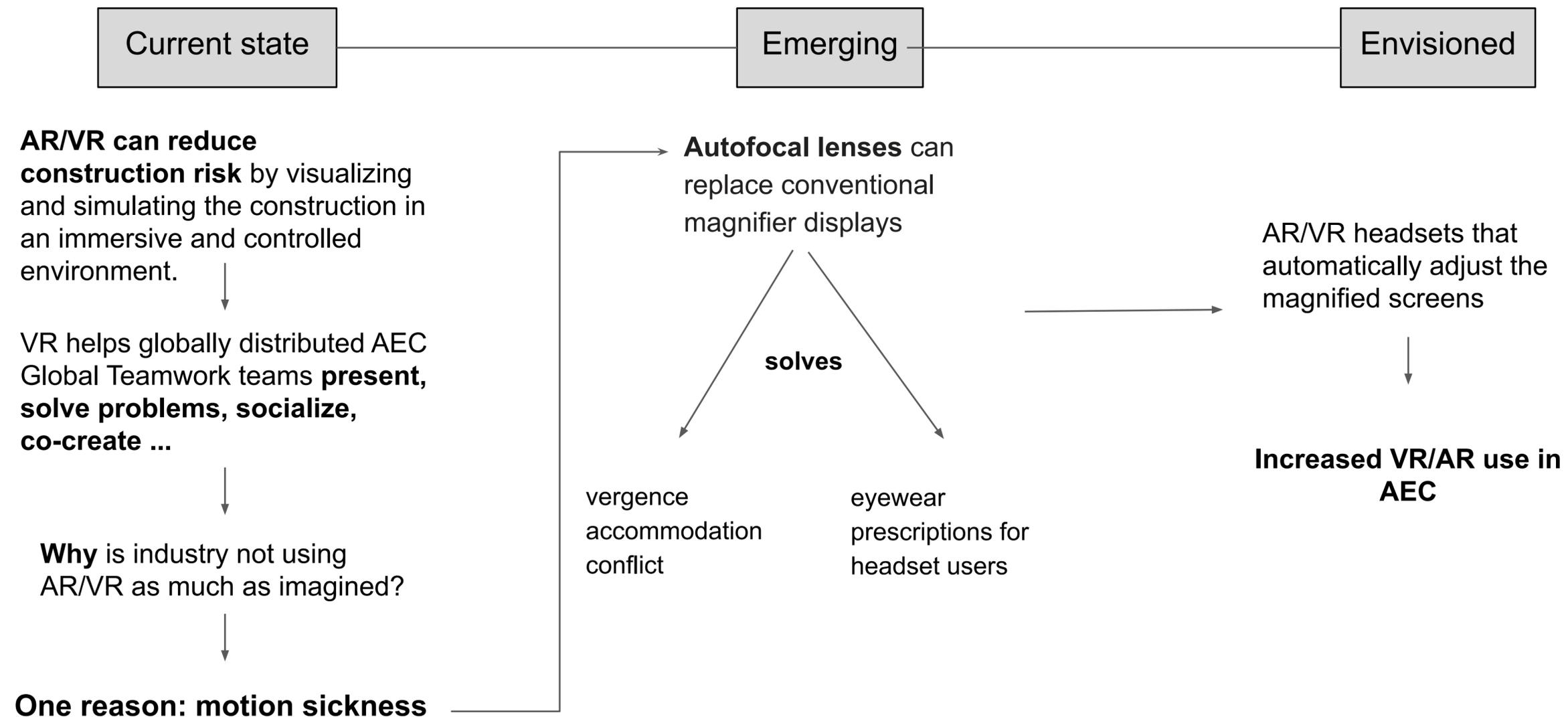
Style Transfer



pix2pix GAN

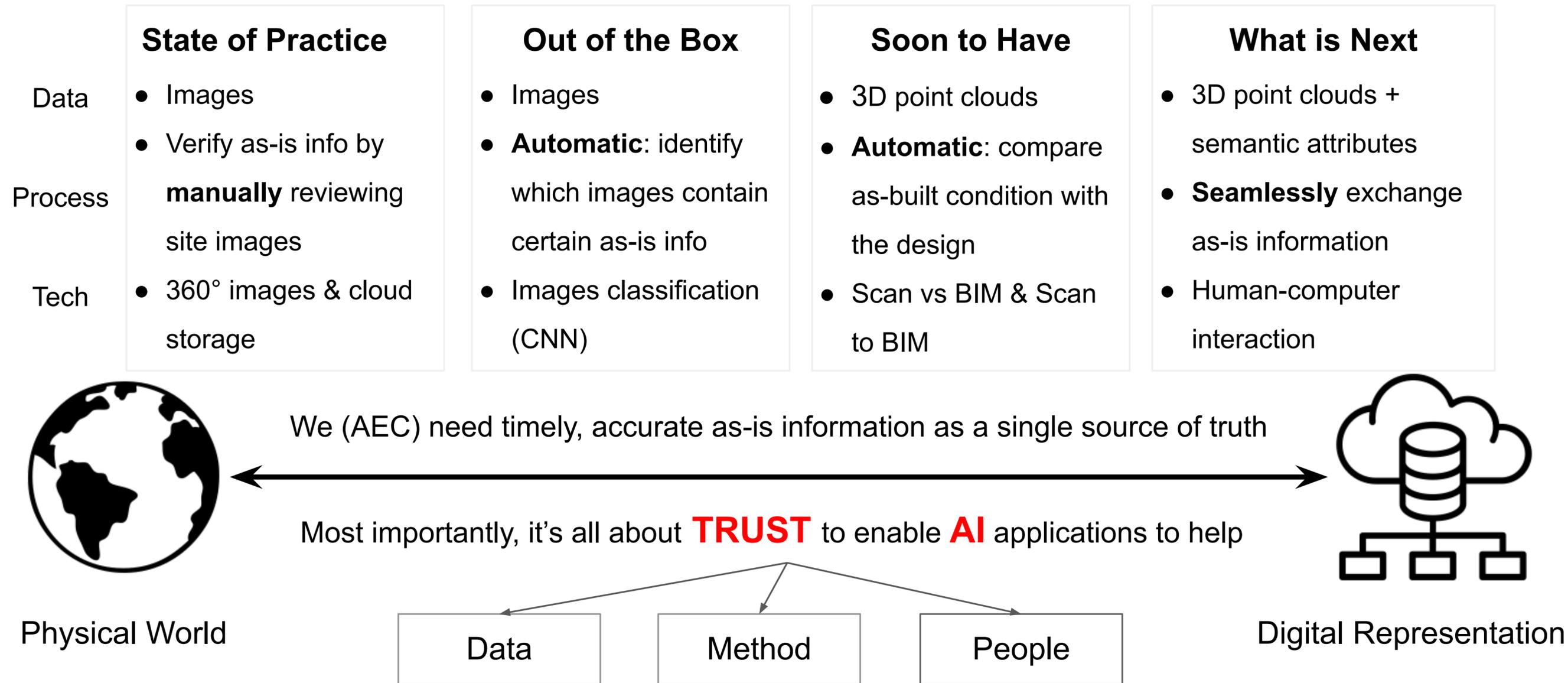
Prototyping with VR/AR

AI4AEC Session | Anton Dy Buncio, Robert Konrad, & Renate Fruchter



It's all about trust.

AI4AEC Session | Andrew Cameron & Iro Armeni



A Human-Centered Perspective on Collaboration with Robots

Keynote Talk | Dorsa Sadigh

Interaction is easy for humans, but challenging when robots enter the equation. Thus, need to formalize collaboration between humans and robots. Two main approaches on how to train robots:

Approach	Maturity	Proposition	Question	Challenge
Human Models	Status quo	Have the robot imitate human behavior through interaction by all teaching it, controlling it, and having it develop a symmetric view	How should a robot represent a human?	Not enough data
Conventions	New idea	Coordination and collaboration, using settings in which human models are not needed	What's the minimal amount of information needed?	Fairly unknown field

Key Ideas

1. Instead of using only human-human interactions, combine them with low-dimensional representations (conventions) which are shared representations that capture the interaction and can change over time
2. We can learn low dimensional representations used by human when controlling robots
3. Robots can incorporate shared autonomy, and enable the user to provide more precise and stylistic motion

Conclusion

Human behavior changes all the time, thus trying to mimic human behavior in isolation as a sole input might not be the right approach.

Key questions going forward using human models and conventions:

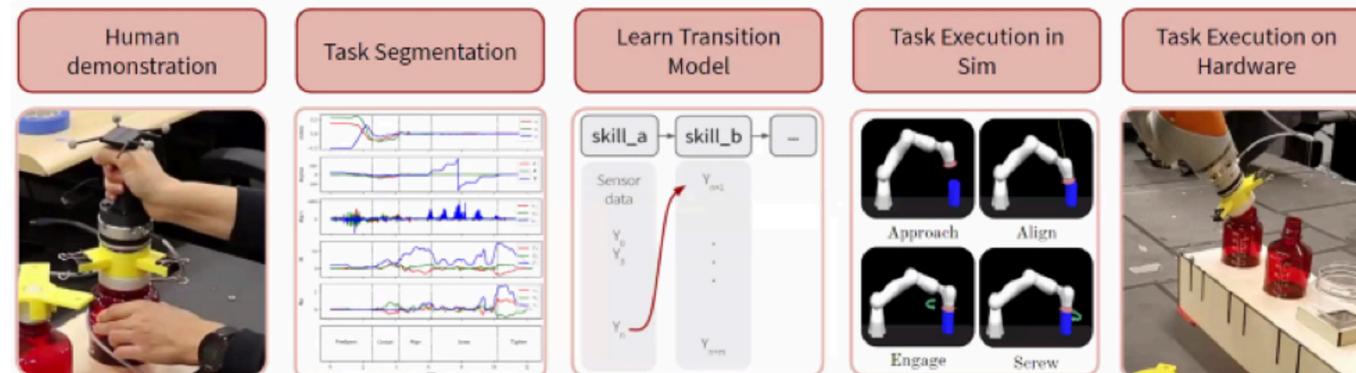
1. *Human models*: What happens on the end of the risk spectrum?
2. *Conventions*: What low dimensional representations are necessary when collaborating with humans?

Robots for Construction

AI4AEC Session | Rolando Mendoza, Cynthia Brosque, & Elena Galbally Herrero

Automate unsafe/repetitive tasks | Optimize for better product fit | Increase Productivity | Standardize to increase prefabrication | Process transparency | Real time production control | Data mining | Address scarcity of skilled labor | Increase safety

ROBOT MANIPULATION



CASE STUDY: DUSTY ROBOTICS (LAYOUT ROBOT)



	Manual (2 operators)		Robot (1 operator)	
	w/set-up (min/lnft)	w/o set-up (min/lnft)	w/set-up (min/lnft)	w/o set-up (min/lnft)
Test 1 (715 lnft)	0.07	0.06	0.27	0.12
Test 2 (1332 lnft)	-	-	0.17	0.07

Brosque et al., (2020)
10.1109/HORA49412.2020.9152871

“Things which are simple to us can be extremely difficult for the robots to execute and things which are difficult for us can be quickly implemented by the robots.”

INDUSTRY APPLICATIONS

Current

- Mortenson & AWS TruePower: Wind Farm Design Optimization
- Built Robotics: Autonomous Equipment
- Virtual Punch List: Assess barricade-off areas to be scanned (indoor & outdoor)

Emerging

- Increase Autonomy & Automation
- Goldbeck’s project: Robot to fix screws using manipulation
 - Parafin: Design optimization to find product fit for a site

Envisioned

- Automation in non-premeditated situations
- Robots with adaptable skills esp. for power lines using haptic controls

CHALLENGES

- Unpredictable/Changing environment in AEC industry makes programming the robot difficult
- Data Integration: Multiple trades are involved and at any point the input data needs to match to the constant updates as the accuracy of the robot depends upon the quality of the input data.

Facility Management

AI4AEC Session | Bruce Mace, Andrew Arnold, Ben Coleman, & Rishree Jain

- Asset documentation that answers what, where, and how is the ‘holy grail’ for many FM tasks - and potentially architectural as well.
 - Identify sources of errors based on systems’ behavior
 - Access to information faster
 - Increase confidence in designs and interoperability between components
- *Challenges:* accurate and uniform standards, occupant privacy, ownership of data.
- In the future:
 - Normalize processes and share data between systems (and processes)
 - Close the gap between design and operation, humans and systems

AI in Contract Law

AI4Law | Julian Nyarko

1		B2B (Business-2-Business)	B2C (Business-2-Customer)
	Value added by AI	Reduction of reading cost	Reduction of contract development cost
	Examples	Privacy protection/user agreements	Construction contracts, mergers, acquisitions

2	Case Study: Reducing the Omissions of Provisions in Human-Drafted Contracts		
	Background	Contracts often miss important provisions, resulting in conflict (e.g., language specifying where disputes are to be resolved)	
	Methods	Thousands of filings with SEC were analyzed using AI to classify them based on the inclusion of provisions	
	Findings	~50% of contracts missing provisions specifying the choice of court, trust forum, and arbitration.	
	Implications	Lawyers are not always consistent in drafting contracts; AI can remedy these deficiencies, quickly and on scale.	

3	Recent Trends & Challenges	
	AI for Contract Development	Definition of 'good' contract depends on the industry (need for customization)
	Smart Contracts	Ambiguity of terms, code review vs contract review, ex-post design cost

Highlights & Insights

from invited participants

Reflection Remarks

by Martin Fischer & Iro Armeni

Reflections

on AI4AEC Colloquium

- **Disruptive innovation:**
 - Start small, eventually replace practices as we know them
 - Learn about the new territory, but primarily about where you came from
- **Future synergies:**
 - Establish connections between AI4AEC topics - currently in isolation
- **AI4AEC & AEC4AI:**
 - Hybrid integration of domains (domain knowledge)
 - Merging domain-specific metrics and evaluation protocols

Future Events

Statistics

on Participants

- ~50%-50%:
 - Practice vs Research
 - Industry vs Academia
- ~75% from AEC
- ~2/3 use AI tools in their work: Sometimes and Frequently

Statistics

on 1st AI4AEC Colloquium

- From not at all (1) to very interesting (5): 4.15 (*weighted average*)
- Right amount of duration, but not longer
- Right balance between AI and AEC, but not more AI focused
- Right mix of AI and AEC speakers, but not more from AI
- Audience participation methods regarded as positive

Future Events

We will be hosting a **2nd Colloquium on AI4AEC!**

Check back at ai4aec.stanford.edu for “*Call for Participation*”

See you next time!

