IRO ARMENI

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EDUCATION

Ph.D., Dept. of Civil and Environmental Engineering, Stanford University **2020**
Ph.D. Minor, Dept. of Computer Science
Area: Computer Vision/Construction Engineering

MSc in Computer Science, Dept. of Informatics, Ionian University **2014**
Area: Informatics and Humanistic Studies

MEng in Architecture, Dept. of Architecture, University of Tokyo **2011**
Area: Digital Design Approaches

Diploma in Architecture, Dept. of Architecture, National Technical University of Athens **2009**
Area: Architectural Engineering

ACADEMIC EMPLOYMENT

Postdoctoral Fellow, ETHZ **2020 - ongoing**
Innovative and Industrial Construction & Computer Vision and Geometry Labs
Departments of Civil, Environmental and Geomatic Engineering & Computer Science

RESEARCH INTERESTS & EXPERIENCE

Interests: Machine Vision & AI for Architectural, Civil, & Construction Engineering, to improve and transform how we design, construct and operate facilities.

PostDoctoral Researcher **2020 - present**
Innovative and Industrial Construction & Computer Vision and Geometry Labs *ETHZ*

- **Spatiotemporal 3D Point Cloud Registration Under Large Changes**: Supervising 4 MS students to create a new benchmark on spatiotemporal 3D point cloud registration of scenes under large geometric and temporal change. Providing detailed guidance on the method, benchmark definition and experiments. Collecting the point cloud dataset in scenes under construction. Defining how often to collect the temporal points. This will be particularly useful when *working with multiple 3D scans of the same area that are captured at different points in time*. *[Nothing Stands Still]*
- **City-scale 3D Reconstruction from visual data**: Co-supervising 2 MS students in their semester project to reconstruct cities in 3D from satellite imagery using implicit functions.
- **Pose Estimation with Movement for Use in AR for Sports** *(early stages)*: Supervising an MS student on their thesis about an Augmented Reality system that automatically detects the pose of an athlete while performing an action, and suggests real-time improvements on the stance. This could be particularly useful for *decreasing injuries in construction workers from performing repetitive strenuous activities*.
- **3D Scene Storytelling** *(early stages)*: Supervising an MS student on their thesis about automatically describing changes in 3D scenes (e.g., rooms) with natural language, using Deep learning algorithms. Among others, this can be useful in automatically creating *reports on modifications in renovated spaces*.
- **Object detection and localization in densely packed settings** *(early stages)*: Supervising an MS student on their thesis about semantic 3D reconstruction of objects and changes in grocery stores.

Doctoral Researcher **2015-2020**

Center for Integrated Facility Engineering & Stanford Vision and Learning Lab *Stanford University*

- **Getting more than object labels toward a complete BIM**: Devised graph representation for multi-modal semantics (e.g., object, spaces), their attributes (e.g., object material, space function), and complex relationships among them (e.g., spatial, magnitude). Developed an automatic method for extraction of object semantics and a user-in-the-loop verification system to reach near-perfect results. Tested this method on a large number of data and publicly released them to the community. *[3D Scene Graph]*
- **Automatically generating as-built Building Energy Models (BEM)**: Devised algorithmic geometric method to generate BEMs given building 3D point clouds. Performed qualitative and quantitative analysis with structured experiments to understand the robustness and the failure points. *[AutoBEM]*
- **Leveraging 3D Deep Learning for fine-grained semantic segmentation of point clouds**: Collaborated on developing a semantic segmentation network for 3D point clouds of indoor spaces. Performed comparisons to a number of state-of-the-art methods for indoor and outdoor settings. *[SEGCloud]*
- **Creating a large-scale multi-modal dataset of indoor spaces**: Developed methods to automatically generate large number of multi-modal indoor instance segmentation semantics (2D, 2.5D and 3D) given annotated 3D mesh and 2D panoramas. Released the generated data to the community to support further cross-modal research. *[2D-3D-S]*
- **Generating 3D semantic models of buildings from point clouds**: Developed a 3D semantic algorithm for hierarchical parsing of entire building 3D point clouds into spaces and objects. Performed experiments against 2.5D and 3D methods using data that I acquired and annotated. Proposed potential applications, such as automatic space manipulation or extraction of space statistics. *[Building Parser]*

Graduate Researcher **2012-2013**

Dept. of Informatics *Ionian University*

- **Detecting Structural Damage in ambient vibration signals**: Developed a method for identifying patterns of structural damage in ambient vibration signals.
- **Suggesting paths to pedestrians based on preferences**: Conducted tests with pedestrians going from A to B under different conditions (shortest distance versus leisurely). Analyzed the results with qualitative and quantitative methods to identify patterns in the different behavioral modes.
- **Making a game out of teaching material properties**: Developed a virtual education game for high school students to learn material properties and Hooke's Law of Physics. *[StretchIT]*
- **Bringing behavioral change with social networks**: Developed a web-based social network that uses methodologies from behavioral change theory for urban awareness. *[What's up neighbor]*

Graduate Researcher **2010-2011**

Dept. of Architecture *University of Tokyo*

- **Informing form-finding with physics and fabrication properties**: Devised a methodology for integrative digital design that incorporates material performance, structure, context, and fabrication/construction in defining form at early conceptual design stages.
- **Exploring 3D structures that are based on material computation and generative algorithms**: Developed generative algorithms that combine the generation of 2D patterns from repeatable elements and material computation of their properties, to create innovative 3D structures. Used the generated patterns to digitally fabricate the 3D structures. *[Digital Matters]*
- **Using material computation and generative algorithms for sustainable cities**: Developed structures that follow similar algorithmic and material principles as above for the rehabilitation of a polluted river in the industrialized area of Kawasaki city, Japan. *[Amphibious Aggregation]*

Undergraduate Researcher **2007-2009**
Dept. of Architecture *National Technical University of Athens*

- **Designing projects of public, urban and private scope**: Among them are rehabilitation of an old quarry, mega-structures, structural design of pedestrian bridge, and more. These designs were performed with a combination of 2D and 3D virtual and physical/digital fabrication tools.
- **Analyzing architectural works**: Used theoretical and digital tools (e.g, drawings, 3D reconstructions, physical models) to analyze in depth the work of influential architects, with the goal to provide either a new perspective or details and analysis on unpublished structures. *[J.A. Coderch | Ioannis Xenakis house in Amorgos Island]*

HONORS & AWARDS

ETH Zurich Postdoctoral Fellowship **2020-2022**
Competitive, university-level funding *for postdoctoral studies on Machine Perception for Architecture, Construction, and Facility Management*

Google Ph.D. Fellowship **2017-2020**
Competitive funding across North America and Europe, *for Ph.D. studies on Machine Perception*

Stanford CIFE Seed Research Award **2016-2017**
Competitive, department-level funding, *for research on "Automated Semantic Understanding of Buildings"*

Stanford School of Engineering Fellowship, Rick & Melinda Reed Graduate Fellowship **2015-2016**
Competitive, university-level funding, *for Ph.D. studies*

EU Marie-Curie Fellowship **2014-2015**
For the project "Automated As-Built Modelling of the Built Infrastructure"

EU Marie-Curie Fellowship **2013-2014**
For the project "BIMAutoGen"

Japanese Government Scholarship (MEXT) **2009-2011**
Competitive, nation-level funding, *for MEng degree*

Erasmus Scholarship, The State Scholarships Foundation, EU **2007**
Competitive, university-level funding, *foreign exchange studies in ETSAM, Spain*

PEER REVIEWED PUBLICATIONS

B. Chen, S. Sax, L. Pinto, F. Lewis, **I. Armeni**, S. Savarese, A. Zamir, and J. Malik, "Robust policies via mid-level visual representations: An experimental study in manipulation and navigation.," in *Conference on Robot Learning (CoRL)*, 2020

I. Armeni, Z.-Y. He, J. Gwak, A. R. Zamir, M. Fischer, J. Malik, and S. Savarese, "3D Scene Graph: A Structure for Unified Semantics, 3D Space, and Camera," in *IEEE International Conference on Computer Vision (ICCV)*, 2019

L. Tchapmi, C. Choy, **I. Armeni**, J. Gwak, and S. Savarese, "SEGCloud: Semantic segmentation of 3D point clouds," in *IEEE International Conference on 3D Vision (3DV)*, 2017. *(Spotlight presentation)*

I. Armeni, O. Sener, A. R. Zamir, H. Jiang, I. Brilakis, M. Fischer, and S. Savarese, "3D Semantic Parsing of Large-Scale Indoor Spaces," in *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016. *(Oral presentation - 4% acceptance rate)*

V. Pătrăucean, **I. Armeni**, M. Nahangi, J. Yeung, I. Brilakis, and C. Haas, "State of research in automatic as-built modelling," *Advanced Engineering Informatics*, vol. 29, no. 2, pp. 162–171, 2015

L. Spedicato, **I. Armeni**, N. I. Giannoccaro, M. Avlonitis, and S. Papavlasopoulos, "A dynamic identification of a historical building using accelerometers with interface modules and a digital synchronization method," in *Key Engineering Materials*, vol. 628, pp. 204–211, Trans Tech Publ, 2015

I. Armeni and K. Chorianopoulos, "Pedestrian navigation and shortest path: Preference versus distance.," in *Intelligent environments (workshops)*, pp. 647–652, 2013

I. Armeni and T. Bristogianni, "More than a machine. j. a. coderch," *Technical Chronicles*, vol. May - June, 2010

MANUSCRIPTS UNDER REVIEW & REPORTS

S. Tao, S. Huang, B. Chen, X. Chen, Y. Hao, S. Savarese, K. Schindler, M. Pollefeys, and **I. Armeni**, "Nothing stands still: A spatiotemporal benchmark on 3d point cloud registration under large geometric and temporal change," in *ISPRS Journal of Photogrammetry and Remote Sensing*, 2022. *(In preparation)*

C. Stucker, S. Huang, Y. Yue, B. Ke, **I. Armeni**, and K. Schindler, "City-scale 3d reconstruction from visual data with implicit functions," in *ISPRS Congress*, 2022. *(In preparation)*

I. Armeni, S. Sax, A. R. Zamir, and S. Savarese, "Joint 2D-3D-Semantic Data for Indoor Scene Understanding," *arXiv preprint arXiv:1702.01105*, 2017

PATENTS

L. P. Tchapmi, C. B. Choy, **I. Armeni**, J. Gwak, and S. Savarese, "Systems and methods for semantic segmentation of 3d point clouds," Apr. 11 2019. US Patent App. 16/155,843

I. Armeni, S. Skaff, and J. Yu, "Devices, systems, and methods for generating multi-modal images of a synthetic scene," Mar. 15 2018. US Patent App. 15/494,352

I. Armeni, O. Sener, A. R. Zamir, M. Fischer, and S. Savarese, "Systems and methods for performing three-dimensional semantic parsing of indoor spaces," Dec. 14 2017. US Patent App. 15/619,422

THESES

I. Armeni, "Automatically generating structured information on the as-is status of facilities from visual data." Ph.D. Thesis, Civil and Env. Engineering Dept., Stanford University, 2020

I. Armeni, "Damage detection and location in structures under ambient vibration using operational modal analysis." MSc Thesis, Dept. of Informatics, Ionian University, 2014

I. Armeni, "An integrative digital design approach: Material performance as the key-element in form-finding." MEng Thesis, Dept. of Architecture, University of Tokyo, 2011

I. Armeni and T. Bristogianni, "Rehabilitation of the former quarries at kopana's hill." Diploma Project, School of Architecture, National Technical University of Athens 2009

I. Armeni and T. Bristogianni, "More than a machine. j.a. coderch." Research Thesis, School of Architecture, National Technical University of Athens 2008

PEER REVIEWED ARCHITECTURAL PROJECTS

Pattern Design w/ Digital Computation **2012**
appeared in *"Patterns and Layering: Japanese Spatial Culture, Nature and Architecture"*
Collaborators: **I. Armeni**, O. Biloborodko, T. Ko

Municipal Theatre of Corfu: Renovation of the Facades and the Entrance Piazza **2012**
1st prize in country-wide architectural competition by the Municipality of Corfu
at the *7th Biennale of Young Greek Architects*
Collaborators: S. Zerefos, C. Tessas, **I. Armeni**, T. Bristogianni

Prototype Housing for the Rehabilitation of Victims of the Extended Fires of August 2007 **2009**
1st of 15 Equal prizes, SEGM Housing Competition for the Fire Victims
appeared in *Bank of Greece Publications*
Collaborators: S. Zerefos, C. Tessas, **I. Armeni**, T. Bristogianni

TEACHING EXPERIENCE

Instructor, ETHZ **Spring 2021, 2022**
Introduction to Visual Machine Perception for Architecture, Construction, and Facility Management [101-0526-00L, website]

- Graduate course in the *Department of Civil, Environmental, and Geomatic Engineering* that attracted students from across departments such as that of Architecure and CS.
- **Course Topic:** Students learn fundamentals of visual machine perception as well as applications of this technology in the fields of architecture, construction, and facility management. They also build skills on computational thinking that bridge the application and technological perspectives of a problem, with coding and critical thinking on how to develop such an application.
- Developed the course curriculum. Taught 75% of the lectures.
- Guided students to develop the final course project.

Instructor, ETHZ **Spring 2021, 2022**
Deep Learning Seminar [263-5904-00L, website]

- Graduate seminar in the *Department of Computer Science* that attracted students from across departments such as that of Mechanical Engineering and Math. Also attracted students from EPFL.
- **Course Topic:** Students acquire a deep understanding of key contributions to the field of deep learning for vision (including a historical perspective and recent work). They also learn to critically read and analyse original research papers and judge their impact, as well as how to give a scientific presentation and lead a discussion on their topic.
- Selected the works to discuss and guided students in the discussion.

Instructor, ETHZ **Autumn 2021**
Mixed Reality [263-5905-00L, website], Co-instructed with *Dr. Federica Bogo* and *Prof. Marc Pollefeys*

- Graduate course in the *Department of Computer Science* that attracted students from across departments such as that of Mechanical Engineering, Architecture, and Math. Also attracted students from EPFL.
- **Course Topic:** Students acquire understanding of the foundations of 3D graphics, Computer Vision, and Human-Machine Interaction and a good overview of state-of-the-art Mixed Reality via guest lectures. They also learn how to build mixed reality apps and to critically analyze and assess current research in this area.
- Co-organized the class.
- Guided students to develop the final course project.

Instructor, Stanford University **Spring 2018, 2019**
AI Applications in the AEC Industry [CEE329, website], Co-instructed with *Prof. Martin Fischer*

- Graduate course in the *Department of Civil and Environmental Engineering* that attracted students from CEE, CS and the Business School, as well as local professionals.
- **Course Topic:** Students learn how to think of and apply AI innovation in the AEC industry, by building skills on computational thinking that bridge the application and technological perspectives of a problem.
- Developed the course curriculum. Taught 70% of the lectures and work sessions.

MENTORSHIP

Mentoring **2021-present**
1 Ph.D. candidate, 3 M.S. student theses, & 7 M.S. students on research projects, *ETHZ*

PhD Mentor [TUM Mentoring] **2021-present**
PhD candidate supervised by Profs. Alex Braun and André Borrmann, *TUM*

External Committee Member on PhD Research Proposal **December 22nd, 2021**
PhD Candidate supervised by Profs. Konrad Schindler and Andreas Wieser, *ETHZ*

Mentoring **2016-2020**
1 Ph.D., 2 M.S., 1 Undergraduate, 1 High School students, *Stanford University*

SAIL Undergraduate Mentor for 2 students **2019-2020**
Stanford AI Lab's mentoring program for undergraduate students in underrepresented groups

Stanford CURIS **2015**
CS Undergraduate Research Internship program
Advised 1 undergraduate student

INVITED TALKS

EC3 Summer School **July 2022**
Title: Computer Vision for the Circular and Lifecycle Assessment of Buildings
European Conference on Computing in Construction (EC3) 2022, Summer School

CAS ETH ARC Digitalisation **November 13th, 2021**
Title: Understanding 3D Visual Data for Architecture, Engineering, and Construction
School of Continuing Education, ETHZ. Switzerland

AI in Design Workshop, UIUC **August 5th, 2021**
Title: Closing the information loop
AI in Construction Institute, University of Illinois Urbana-Champaign. USA

8th Computational AEC, Melbourne **July 29th, 2021**
Title: AI and Computer Vision for AEC: The Good, The Bad, and The Ugly
Computational AEC Group. Melbourne, Australia

IAARC@Edinburgh **July 16th, 2021**
Title: 3D Scene Graph: A structured building information representation toward normalizing ego- and allo-centric stakeholder communication
IAARC@Edinburgh and University of Edinburgh. Scotland

CEE329: AI Applications in the AEC Industry **April 22nd, 2021**
Title: Introduction to Computer Vision for Architecture, Engineering, Construction, and Facility Management
Dept. of Civil and Environmental Engineering, Stanford University. USA

University of Patras, Greece **November 9th, 2020**
Title: Automatic generation of structured information on facility as-is status from visual data
Dept. of Civil Engineering, University of Patras. Greece

AIA Symposium on AI in Architecture, Engineering, and Construction **October 20th, 2020**
Title: Automatic generation of structured information on facility as-is status from visual data
ETH Zurich Webinar Chaired by Benjamin Dillenburger & Matthias Kohler link

Autodesk AI Lab Sharing Session **September 30th, 2020**
Title: Automatic generation of structured information on facility as-is status from visual data
Autodesk, AI Lab

CEE595: AI in Construction Webinar **September 17th, 2020**
Title: Automatic generation of structured information on facility as-is status from visual data
Dept. of Civil and Environmental Engineering, University of Illinois Urbana-Champaign. USA

ECCV Workshop: Long-Term Visual Localization under Changing Conditions **August 28th, 2020**
Title: Automatic generation of structured information on facility as-is status from visual data
Workshop in European Conference on Computer Vision, 2020 (link)

1st Colloquium in AI4AEC **August 20th, 2020**
Title: It's all about trust.
Co-presented with Andrew Cameron. Is AI Ready for the Building Industry? (and vice-versa) (link)

Technical University of Munich (TUM) **July 22nd, 2019**
Title: Automatic generation of structured information on facility as-is status from visual data
Dept. of Civil, Geo & Environmental Engineering, TUM. Germany

Ecole Polytechnique Fédérale de Lausanne (EPFL) **June 28th, 2019**
Title: Automatic generation of structured information on facility as-is status from visual data
School of Architecture, Civil & Environmental Engineering, EPFL. Lausanne, Switzerland

Swiss Federal Institute of Technology Zurich (ETHZ) **June 27th, 2019**
Title: Automatic Generation of As-Built BIM by Parsing whole-Building Scans
Dept. of Civil, Environmental & Geomatic Engineering, ETHZ. Switzerland

Imperial College **June 26th, 2019**
Title: Automated semantic & operational understanding of buildings
Dept. of Civil & Environmental Engineering, Imperial College. United Kingdom

Technical Chamber of Corfu & Ionian University **January 7th, 2019**
Title: 3DSCAN-to-BIM: From Tape Measure to Robotics
Technical Chamber of Corfu & Dept. of Informatics, Ionian University. Greece

Engineering News Record (ENR) **July 26th, 2018**
Title: Getting the ROI out of AI
Webinar

Chicago Society for Construction Solutions **March 28th, 2017**
Title: Reflecting building changes and is-status in construction and use phases
Chicago, USA

Princeton University **May 16th, 2016**
Title: Semantic Parsing of Large-Scale Indoor Spaces
CS Dept., Princeton University. USA

Engineering News Record Future Tech **June 2nd, 2016**
Title: 3DScan-to-BIM: Automatic Generation of As-Built BIM by Parsing whole-Building Scans
San Francisco, USA

PRESS COVERAGE

AI in Podcast, 2021, 3D Scene Graph and AI-AEC applications, [link]

Computer Vision News, 2018, *Women in Computer Vision*, [link]

Stanford News, 2016, *Building Parser*, [link]

SPAR3D, 2016, *Stanford Innovation Makes Point Clouds Smart*, [link]

KZSU Stanford Unviersity's radio station, 2016, *The Modern Architect*, [link]

PROFESSIONAL SERVICE

Organizer **2021-2022**
2nd Colloquium on AI4AEC, Built to Change - Let's reuse buildings not AEC practices [link]
Session 1 - 23/11/2021 | Session 2 - 17/01/2022 | Session 3 (upcoming) - 09/02/2022

Area Chair **November-February 2022**
Computer Vision and Pattern Recognition (CVPR) Conference 2022

Co-Organizer **October 15th, 2021**
AI in AEC Workshop
AI + X Summit 2021, ETHZ AI Center, Switzerland

Co-Organizer **2021**
1st Workshop and Challenge on Computer Vision in the Built Environment for the Design, Construction, and Operation of Buildings [link]
Computer Vision and Pattern Recognition (CVPR), Conference, 2021

Organizer **August 19th-20th & 26th, 2020**
1st Colloquium on AI4AEC, Is AI Ready for the Building Industry? (and vice-versa) [link]

Pop-up Guest Lecture **October 19th, 2019**
Workforce Virtual Design and Construction (VDC) BIM Bootcamp

Student Volunteer Chair **2019**
International Conference on Computer Vision (ICCV), Conference, 2020

Challenge Advisor **2019**
Scene Understanding and Modeling (SUMO) Challenge

Program Director & Curriculum Chair **2016**
Stanford Artificial Intelligence Laboratory's Outreach Summer Program (SAILORS)

Website Chair **2016**
4th International Conference on 3D Vision (3DV 2016)

Admissions Chair **2015**
Stanford Artificial Intelligence Laboratory's Outreach Summer Program (SAILORS)

Co-Organizer **2014**
Bay Area Vision Meeting (BAVM)
Organizer: Computer Vision and Geometry Lab, Stanford University

Co-Organizer **2014**
Office of Naval Research (ONR) Workshop on Structured Learning for Scene Understanding
Organizer: Computer Vision and Geometry Lab, Stanford University

Reviewer for:

- Journal of Computing in Civil Engineering (**CPENG**)
- Journal of Automation in Construction (**AUTCON**)
- European Conference on Computing in Construction (**EC3**)
- Design Computation Conference I/O (**DC I/O**)
- IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**)
- International Conference on Computer Vision (**ICCV**)
- European Conference on Computer Vision (**ECCV**)
- International 3D Vision Conference **(3DV)**
- Transactions on Pattern Analysis and Machine Intelligence (**TPAMI**)
- Transactions on Visualization and Computer Graphics (**TVCG**)
- International Journal of Computer Vision (**IJCV**)
- Image and Vision Computing Journal (**IMAVIS**)
- ISPRS Journal of Photogrammetry and Remote Sensing ((**P&RS**))
- Asian Conference on Computer Vision (**ACCV**)
- Transactions on Mobile Computing Journal (**TMC**)

Memberships:

- Member, American Society of Civil Engineers (**ASCE**)
- Licensed Professional Engineer, Technical Chamber of Greece

PROFESSIONAL EMPLOYMENT

Canon U.S.A. | Senior Research Intern **2016**
Canon U.S.A., Imaging System Research (ISR), California, USA

University of Cambridge | Graduate Researcher **2013-2015**
Dept. of Engineering. Area: Computer Vision/Construction Engineering
Cambridge, UK

Corfu Museum of Asian Art | Architect Engineer **2012-2013**
Architectural Design and Exhibition Planning
Corfu, Greece

Green Lab | 3D Design Consultant **2013-2014**
Dept of Informatics, Ionian University. Project: Digital Representation of Historical Buildings in the Ionian Islands
Corfu, Greece

Freelance | Architect Engineer **2011-2013**
Architectural Design, Landscape and Interior

Corfu, Greece

Zerefos Tessas Architects | Intern **2008-2009**
Architectural Design
Athens, Greece

REFERENCES

From Civil and Env. Engineering

Daniel Hall
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ETHZ
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From Computer Science

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