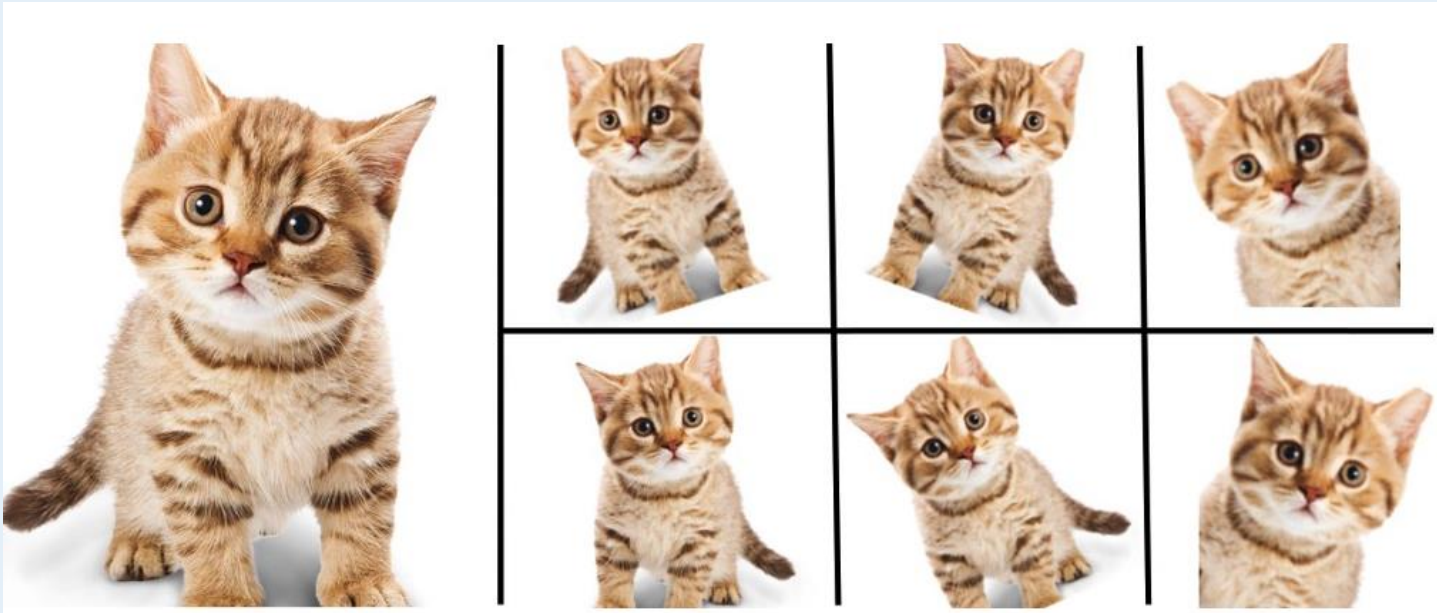
CVPR
JUNE 16-21, 2019
LONG BEACH • CALIFORNIA
DAILY

Computer Vision and Pattern Recognition

Tuesday



Enlarge your Dataset

Workshops

Presenting Work by:
Armen Avetisyan
Ekin Dogus Cubuk
Matthias Hein
Yoni Kasten

Welcome by General co-Chair:
Larry Davis

Today's Picks by:
Shuangjun Liu

Women in Computer Vision:
Vagia Tsiminaki

In cooperation with
Computer Vision News
The Magazine of The Algorithm community

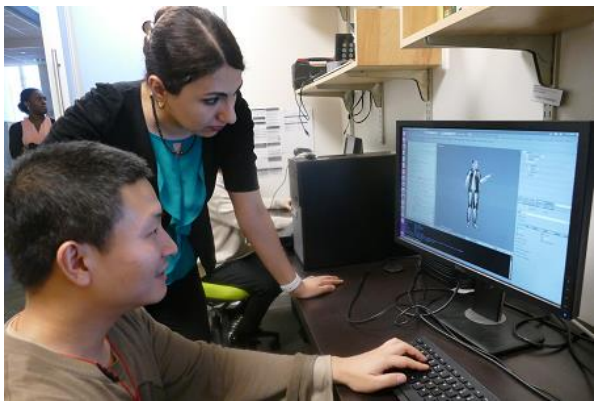
A publication by
RSIP VISION

Shuangjun's Picks

CVPR Tuesday DAILY

For today, Tuesday 18

Shuangjun Liu is a 3rd year PhD student of the Augmented Cognition Lab (ACLab) at the ECE Department of Northeastern University in Boston, USA. He enjoys traveling and photography, as well as figuring out things and exploring new territories. For these reasons, research work appeals to him a lot: "*I especially like to solve real-world problems. With rapid emerging works towards various real-world applications, computer vision and machine learning no doubt have become one of my favorite research directions. One of the intriguing topics for me is how to make a machine understand an image like a human*."



"Currently, my research focus is centered around solving visual perception problems including human pose estimation under specific contexts with data limitation, such as medical care. In particular, I am interested in bringing domain knowledge into the deep learning structures through the use of physics-guided simulation as a means for data augmentation.

I am glad to be at CVPR19 to learn great works and talk to the community. I am presenting two posters on behalf of my lab members at ACLab:* "Infant Contact-less Non-Nutritive Sucking Pattern Quantification via Facial Gesture Analysis" *(at workshop on Augmented Human) and* "Introduction to Indoor GeoNet" *(at workshop on 3D Scene Understanding for Vision, Graphics, and Robotics)"

Shuangjun's picks of the day:

Orals:

1.1A-4 Kervolutional Neural Networks
1.1B-76 DeepSDF Learning Continuous Signed Distance Functions for Shape Repr.
1.2B-121 Progressive Pose Attention Transfer for Person Image Generation

Posters:

1.2-6 Universal domain adaptation
1.2-92 Exploiting Temporal Context for 3D Human Pose Estimation in the Wild
1.2-140 Dense Intrinsic Appearance Flow for Human Pose Transfer

Good morning CVPR!

For the 4th year, **CVPR** and **Computer Vision News** (published by **RSIP Vision**) join forces to bring you a **CVPR Daily** magazine during the main program of **CVPR2019**.

This CVPR Daily offers you once again the highlights of yesterday's (Monday) program together with previews of today's program. We join the **General Chair Larry Davis** in thanking **Nicole Finn** and her exceptional team at **CtoC**, both for the perfect organization (even with **9,300 participants!**) and also for circulating once again this CVPR Daily mag. Enjoy the reading and the conference!

Ralph Anzarouth
Editor, **Computer Vision News**
Marketing Manager, **RSIP Vision**

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CVPR Tuesday DAILY

General Chair - Larry Davis

Larry, CVPR 2019 is an exceptional CVPR. What are your first impressions?

My first impression is just the scale is tremendous. It's unbelievable. I was the general chair of CVPR 1988 in Ann Arbor, Michigan – I've done it a few times – and at that meeting we had at most 125 papers presented and several hundred people. The single largest expense the meeting incurred was Federal Express to mail out hard copy versions of the papers to the reviewers. The whole thing was just tiny and small and intimate.

No one got lost at the convention center.

No, nobody got lost at the convention center! Everybody knew everybody else. Finding somebody was just not a problem. Certainly, it's a challenge here navigating the meeting. You have hundreds of workshops and tutorials. Which ones do you go to? Luckily all the material is available in one form or another online. You can review it after the conference. There's no way you can see it all at the meeting. There's no way any one person could see it or absorb it all, but for those things that you're interested in you've just got to give up on the possibility of seeing it all while you're here and go through it after the conference.

How to make the right choices, so that attendees can at least find the best for them?

The best is hard. What I try to do is go to the sessions in which the best papers are being presented. Pick an oral session. Sit there. Going back and forth between them is going to be really problematic. There are good papers everywhere – not only at the oral sessions but also at poster sessions. People tend to move around listening to the famous people that speak at the workshops. I do that myself.

What do you see from a technology point of view that is completely different now from Ann Arbor 1988?

Well, it's not even comparable. I don't think we had a single industrial sponsor in 1988. There were only a few niche industries in which people were doing computer vision. Some type of early industrial inspection systems and a little bit of surveillance, but really not very much back then. Today, if you walk the exhibit floor, you just see this dizzying array of companies with interesting applications. This is mostly social media and autonomous systems. The opportunities for young people today in the field are fantastic. That's why we have hundreds of thousands of square

feet being occupied by vendors. At a lot of conferences, they're there to sell to one another; here, they're here to collect future employees.

Do you have a message for first-time attendees here at CVPR?

You shouldn't be embarrassed to introduce yourself to anybody. In my capacity as university professor, I'm always looking for new students who might be interested in doing a PhD at the University of Maryland. In my capacity as an Amazon employee, I'm always interested in looking at people who may be good employees for the organisation. This is going to be true for anybody else here at the meeting. Sure, you come here to see people you know – there's a socialisation aspect – but if you're a new person here, it's an opportunity to create your own network with other people in your generation and an opportunity for you to meet some of the more established people in the field. Don't be shy. Walk up, say hello, start talking about what you're doing. If they're busy, they'll tell you. If they're not, they'll be happy to engage in a conversation.

What can you tell us about the organisation of the conference?

The only reason we can run a conference of this scale is because of the fantastic support we get from people like Nicole and her staff. They're just unbelievable. I did all the logistics in 1988 myself, including how many pots of coffee we should have in the afternoon breaks. That would just be impossible today. Without the kind of institutional memory that Nicole and her staff have from one meeting to the next, and their people skills in dealing with endless problems coming in at a machine-gun rate, the whole thing would just collapse. They're incredible.

"Don't be shy. Walk up, say hello!"

Thinking ahead to CVPR 2020, what would you say to your successors?

Well, good luck, because if we went from 6,000 attendees to 9,300 this year, that kind of growth can't go on forever. It's just biologically impossible, but if it goes on for another year and you're looking at attendees of 10-12,000 in Seattle, it's going to be very difficult to manage. We had a few political problems on the way, and you've got to be very sensitive to those. Of course, we're an academic community. This is not a trade show. This is a real research conference and I think everybody who's involved in the organising of these conferences wants to have the broadest participation possible. They want to stay away from politics 100 per cent and give everybody a chance to participate. You've got to be very sensitive to things that have happened. Also, this year, we cut off registration, but we weren't organised enough to make sure that the workshops knew that they couldn't tell anybody else that they could come to the conference. We had a few people who were justifiably upset who got very late workshop invitations for one reason or another. They were really excited, bought their plane tickets, but then weren't able to register. We know we're going to hit our registration limit in 2020 and we have to do a better job of getting the whole thing organised so that we meet expectations and don't disappoint anyone.

We're close to 10,000 people here all together being part of or contributing to the organisation of the meeting. We're glad you're all here. Enjoy it and learn a lot!

Scan2CAD: Learning CAD Model Alignment in RGB-D Scans

Armen Avetisyan is a PhD student at TU Munich working with Matthias Niessner. He speaks to us ahead of his oral and poster today.

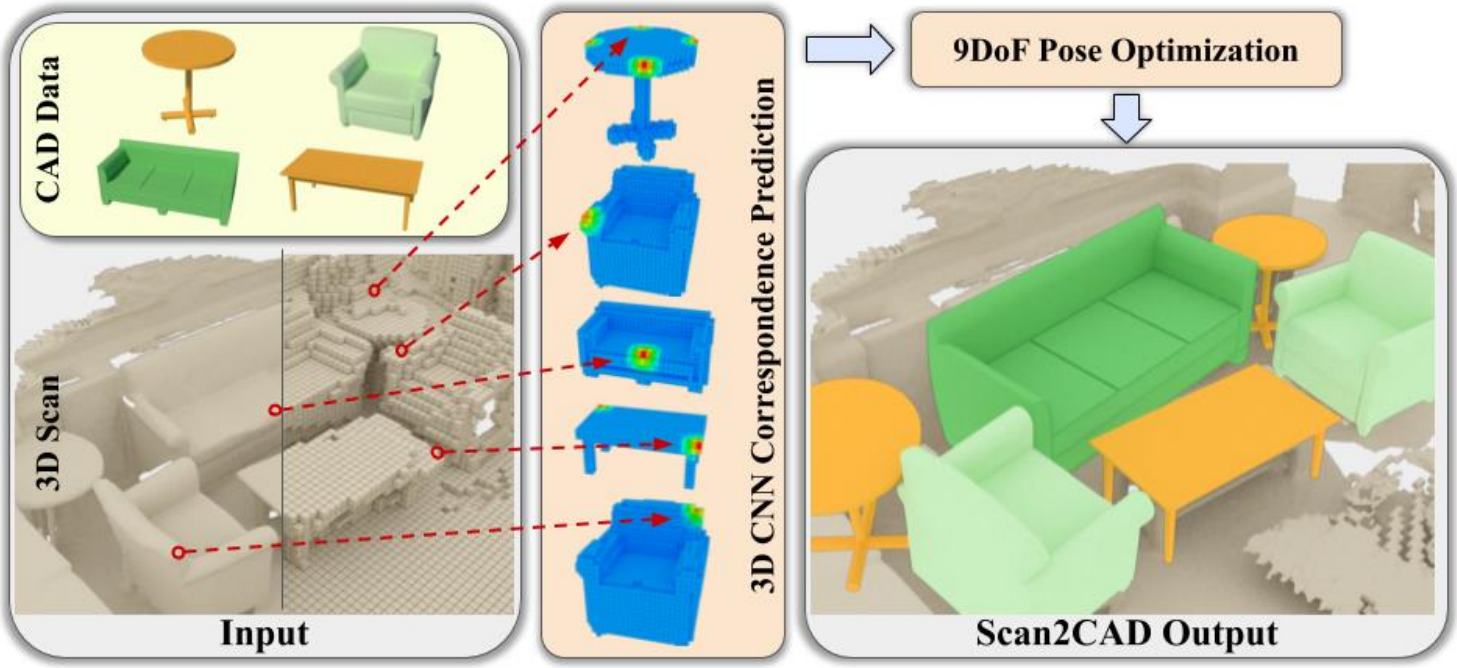
Armen tells us that in 3D scanning, there are two major problems. One problem is noise, but with really good sensors and cameras you can solve that. One thing that cannot be solved is incomplete capture. For example, when you scan a bedroom, if you don't scan what's beneath the bed you will never see it. Even the best sensor won't tell you. Scan2CAD detects objects from a 3D scan. It takes the bed and replaces it with a complete geometric bed.

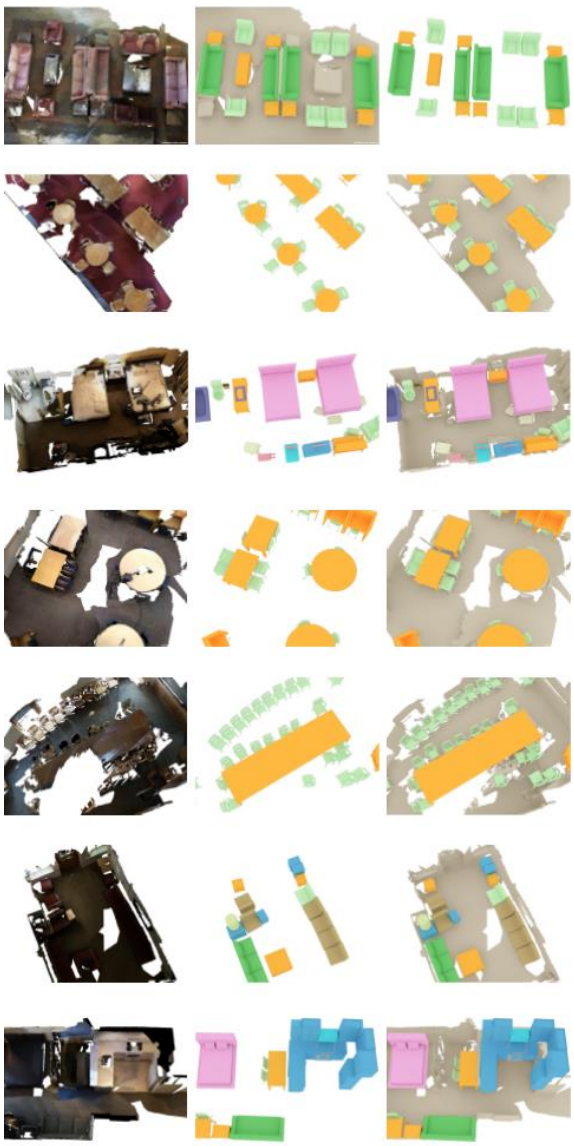
When you replace the noisy scan with a compact CAD model representation, scan quality is improved, and you can use it for VR environments or save all the information in much smaller memory. You could take a scan of your house or your room and transform it into a game so that you could play, not with a random environment, but in your house!

Armen says the challenge of this is that a raw 3D scan is really just a bunch of triangles. There is no segmentation of objects. You don't have objects; you just have a triangle soup. It's a challenge to understand which triangles make an object and which don't make an object. It's just wall or just floor. Deep learning can help solve this.

He explains: "*Deep learning gives you this really strong semantic power. That means this data-driven approach where you can't really describe mathematically what a chair is, but*

"Deep learning gives you this really strong semantic power. That means this data-driven approach where you can't really describe mathematically what a chair is, but with lots of examples of a chair you can infer what a chair is!"





with lots of examples of a chair you can infer what a chair is. In our project, Scan2CAD, when we have lots of noisy chairs or incomplete chairs, we have lots of counter examples of perfect quality chairs. That's why we can learn to transform bad quality scans into high-quality chairs."

Armen points out that one shortcoming of the project is that **to make a better-quality reconstruction takes a long time**. They are planning to implement a real-time interactive approach which will mean, for example, having a VR goggle, and while 3D reconstructing, transform the whole world into CAD models.

Finally, Armen tells us what it is like to work with **Matthias Niessner**:

"Working with Matthias is really interesting. Matthias thinks very big. He is not happy with small steps or incremental improvements. He is always the big vision. Sometimes as a PhD student you want to work on something that is safe, but Matthias makes you give 100 per cent of yourself."

To learn more about this work, come along to Armen's oral [1.2C] today at 14:42 and to his poster [178] at 15:20-18:00.

Why ReLU Networks Yield High-Confidence Predictions Far Away From the Training Data...

Matthias Hein is a professor at the University of Tübingen in Germany. He speaks to us ahead of his oral and poster today: *Why ReLU Networks Yield High-Confidence Predictions Far Away From the Training Data and How to Mitigate the Problem*.

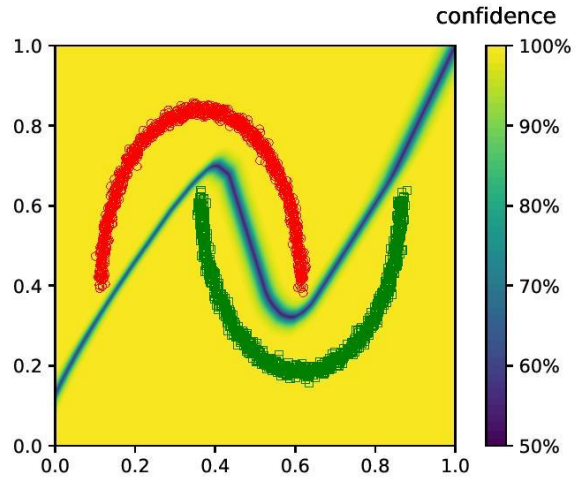
Matthias tells us that this work proves that so-called ReLU networks, which are basically all existing networks which are out there using ReLU activation function or max pooling or average pooling for convolution layers, produce arbitrarily high-confidence predictions far away from the training data. This is clearly a problem in safety-critical applications because the confidence of a classifier cannot be used for triggering human intervention.

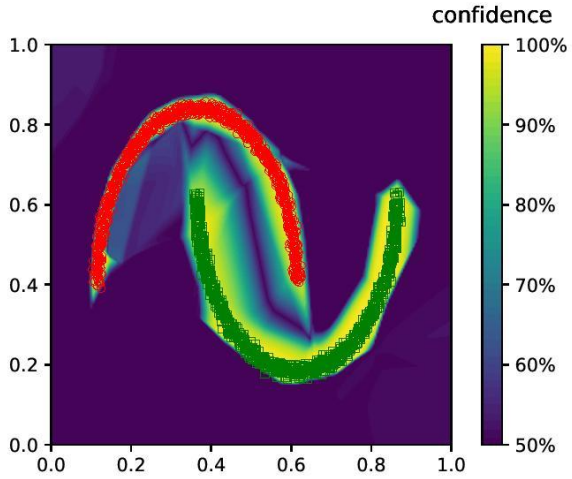
He proposes a new training method, adversarial confidence enhanced training – inspired by adversarial training – to at least mitigate the effect of this. This generates noise images then checks in a certain neighborhood around this noise image for the maximum confidence. In the training process, they feed this back into the neural network and say, on this point, please produce a uniform confidence.

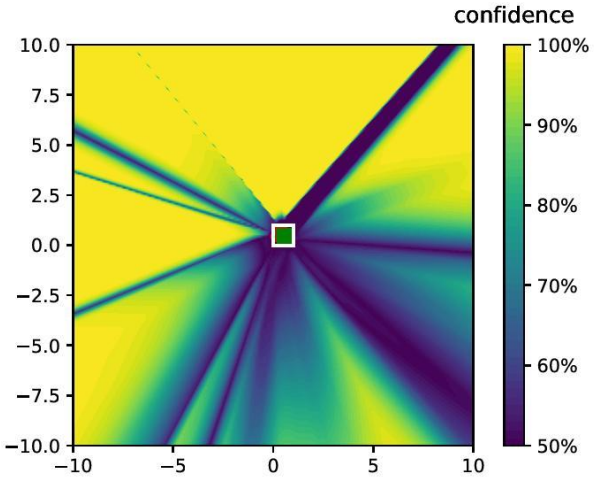
Matthias thinks that, to some extent, with neural networks we are in the wild wild west. He wants to bring some kind of rigour back to the deep learning world. One property that is typically expected from a classifier is that it should know when it does not know. Some classifiers have that property, even provably, but neural networks obviously don't have it and he believes this should be widely known.

He tells us that he's had this theory for a couple of years now. He didn't think it was interesting because he thought people already knew it, but then when he occasionally told it to people, they were surprised, and he realised he should write it up.

Matthias explains: "*I'm more from the machine learning community. I'm basically an outsider to computer vision. This method which mitigates at least this problem is inspired by adversarial training, by this robust optimization perspective, and I think this is a very valuable perspective because it's tackling the worst case. We also propose in this paper another technique where we take noise images and say, on this, produce uniform confidence. The problem is then we can still adversarially look in a neighbourhood for the instance which produced high confidence and we are always successful. This simple method does not work. You need this kind of robust optimization technique in order to solve the problem.*"







"Neural networks are provably overconfident far away from the training data"

"Adversarial Confidence Enhanced Training (ACET) mitigates the problem..."

"... but asymptotically the problem of overconfident predictions persists"

Matthias says that the next step is to provide a modification of neural networks so that they have provably the guarantee that far away from the training data we have uniform confidence over all the classes.

He adds that in general, we need provable guarantees for neural networks. This can have several flavours, but we have to ensure that what we are doing does not produce something harmful for society. Computer vision is applied in safety-critical domains, such as autonomous driving and medical applications, so it's very important that we know what we are doing.

To find out more, come along to Matthias' oral [1.1A] at 09:23 today and to his poster [5] at 10:15-13:00.

AutoAugment: Learning Augmentation Strategies from Data

Ekin Dogus Cubuk is a research scientist at Google Brain. Before this, he got his PhD in physics, but used to apply machine learning to physical systems. He did the residency at Google Brain which is for people who have an interest in deep learning but are not experts. At Google Brain, he has been working on AutoML applications, mainly for data augmentation. He is a first-timer at CVPR and speaks to us ahead of his first oral presentation.

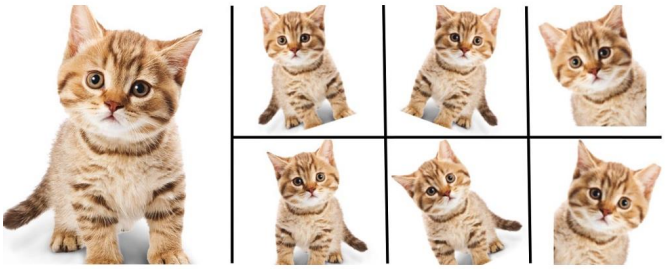
Even as he was doing his PhD, Dogus says it was clear that machine learning had many interesting directions. He says if you look at the research divisions now, all the physics PhDs are using their physics skills in machine learning. They are also interested in using machine learning to study physics, and there's still an active research area at Google Brain and Google Accelerated Science.

Dogus finds that data augmentation is an underutilized tool in deep learning. Although there are many papers that come up with new data augmentation operations – like mixup, Cutout, geometric operations – it's not clear how you would combine them and get the optimum result. It's interesting to ask how far you can push the impact of data augmentation on these models. In this paper, they tried to combine the already existing operations and get as good a result as possible on the test set.

"A lot of the work is focused on architectural improvements, rather than processing data!"

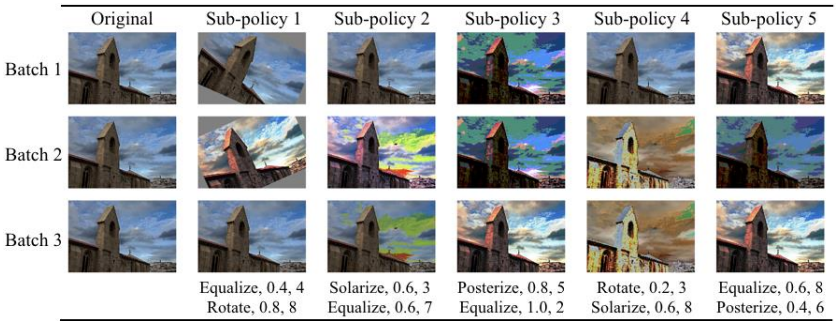
During the process, they actually found out some more fundamental and important things that should be done for data augmentation. One of them is variability. Diversity in your data augmentation policy, for example. Most of the time when people apply operations, they either apply it to every mini-batch and every image, or they don't apply it. Cutout is very helpful on some data sets, but how you use it is you apply it to every single image and every single mini-batch. They found that instead of having one strategy, having hundreds of strategies and choosing one of them randomly for each image in each mini-batch actually gives you a huge improvement. If you were to just do that and not use any of AutoAugment's search capability, you already get a big improvement.

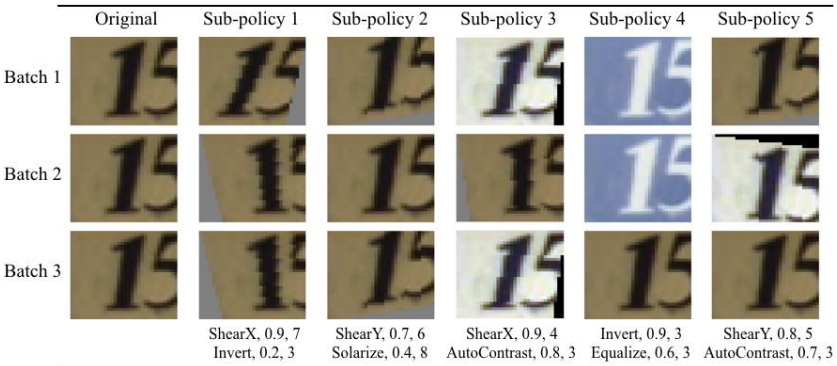
He explains: "***Accuracy with deep learning models is important, and data augmentation is an easy but impactful way of improving the accuracy***. *A lot of the work is focused on architectural improvements, rather than processing data. Since experts already have an idea of what symmetries are, and it's clear how they can utilise those symmetries to augment the data, it would be good to increase the accuracy. Something else we have been seeing recently that we didn't necessarily think about when we were writing the paper is that it seems that increased data augmentation helps a lot with robustness. Recently there was an ICML workshop here on robustness for machine learning models to common corruptions and noise. What several people found is that* ***AutoAugment leads to the best robustness***. *Although it was actually only trained for increased validation accuracy.*"



Enlarge your Dataset

In terms of next steps, Dogus says that they want to apply this idea to other domains. Not just image classification, but **video and object detection**, for example. They recently had a paper, **SpecAugment**, about applying AutoAugment to speech to benefit speech rd to get to work. Since their work, other people have reproduced it with Bayesian optimization or with population-based training or a few other methods, and Dogus is encouraged by how easy it is to get the same results with different optimizers.





"Accuracy with deep learning models is important, and data augmentation is an easy but impactful way of improving the accuracy!"

To learn more about this work, you are encouraged to come along to Dogus's oral [1.1A] today at 10:04 and poster [12] at 10:15-13:00.

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Global Leader in Computer Vision & Deep Learning

COMPUTER VISION PROJECT MANAGEMENT

Computer Vision Project Management is a series of lectures and articles conducted by RSIP Vision's CEO Ron Soferman, many of which are published as a regular column on magazine Computer Vision News, in the project management section.

Everything a project manager in computer vision should know... **at the click of a button**

- How to implement Deep Learning
- Team Leadership and Management
- Validation and Test Techniques
- How to solve all kinds of challenges
- What are the best practices?

"Even the biggest hammer cannot replace a screwdriver!"

Did you miss an article? No worries, you can find them all in the **Project Management section of RSIP Vision's website**

Top: the 9th IEEE international workshop on "Analysis and Modeling of the Faces and Gestures" was kicked off with a keynote from Stan Z. Li from Westlake University, China: "*Heterogeneous Face Recognition: Research and Recent Advances.*" Thank you Sarah Ostadabbas for reporting.

Below: runner-up best paper award for "*SizeNet: Weakly Supervised Learning of Visual Size and Fit in Fashion Images*" in Understanding Subjective Attributes of Data Focus on Fashion and Subjective Search FFSS-USAD workshop. Author Nour Karessli (left) is greated by Diane Larlus (Naver Labs Europ) and Nicu Sebe (University of Trento, Italy).

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Large audience yesterday at the Applications of Computer Vision and Pattern Recognition to Media Forensics workshop. Below, Matthias Niessner answering questions from the audience. Standing in the center of the photo, organizer Cristian Canton. Sitting in the third row, co-organizer Laura Leal-Taixé. In the small picture, winner of best paper award Luisa Verdoliva.

The Medical Computer Vision (MCV) workshop consisted of a series of invited presentations from prominent researchers from both industry and academia who described recent successes and challenges in developing methods for medical image analysis. Co-organizer Tal Arbel told us she is very satisfied with the workshop's huge success. Below, speaker Diana Mateus.

CVPR Tuesday DAILY

Global Projective SFM Using Algebraic Constraints on Multi-View Fundamental Matrices

Yoni Kasten is a Computer Vision PhD Student at Weizmann Institute of Science in Rehovot, Israel. He speaks to us about his paper, which explores a unique method for solving the problem of structure-from-motion. This paper is co-authored with Amnon Geifman, Meirav Galun and Ronen Basri.

Structure-from-motion is a classic problem and a very important one for automatic 3D modelling using 2D images. Yoni claims his method is the first one that solves the projective structure-from-motion problem directly from a set of fundamental matrices, where the fundamental matrix defines the relationship between any two images of the same scene.

The method produces one consistent structure of the scene and the cameras, from all the available **fundamental matrices**. To do this, it uses a big matrix called a multi-view fundamental matrix which contains as blocks all the fundamental matrices between pairs of cameras. The paper defines and proves sufficient conditions on the n-view fundamental matrix that makes this matrix consistent with a set of cameras. After optimising for such consistent n-view fundamental matrix from the measurement pairwise fundamental matrices, the method can then extract all the cameras in one step directly from the fundamental matrices.

A challenge in doing this is that the fundamental matrices that come from the measurements are noisy and there are also missing entries that have to be completed somehow. Yoni explains the optimization process:

"*We actually had to optimise for **rank constraints** on the matrices, which is very challenging because optimizing with rank constraint is **non-convex optimization**. We had to somehow perform the optimization with the constraints and still get good enough results. We solved this using a successful approach called **ADMM**. We also had to build a graph of all the cameras and extract a triplet cover of the graph. This way we could complete all the missing entries and generate consistent cameras*."

Yoni thinks that this is **a very practical approach**. He says that you can just take a set of images which have correspondences and generate a big structure of a scene. They have built several sights that people have captured with their cameras of famous structures in different places around the world (for example: the **Église du Dôme in Paris** which is showed on the previous page).

In terms of next steps, now that the problem has been solved in an **uncalibrated setting**, Yoni would like to extend the work to a **calibrated setting**. In the calibrated setting, where the calibration of the cameras is known, he would use essential matrices instead of fundamental matrices and then generate a calibrated structure which means that the angles of the scene are defined correctly. In the projective set-up, the angles are not unique and there is some projective ambiguity, but in the calibrated setting, the angles are well defined.

If anyone wants to use this method, the code is available here.

To find out more about this work, come along to the poster session [79] today (Tuesday) from 15:20-18:00.

"[This] method is the first one that solves the projective structure-from-motion problem directly from a set of fundamental matrices"

"This is a very practical approach!"

At CVPR 2019, Vagia Tsiminaki presents her paper: *3D Appearance Super-Resolution With Deep Learning*, along with Yawei Li, Radu Timofte, Marc Pollefeys, Luc Van Gool, which tackles the problem of retrieving high-resolution (HR) texture maps of objects captured from multiple viewpoints.

Read more interviews with women scientists

Vagia, can you tell us about your work?

First of all, thanks a lot for inviting me. Now, I have recently joined IBM Research in Zurich in the computer vision team. We are working on a spatial cognition project.

Tell us about this. We are curious to know what you do!

It's still at the beginning of this project. It's been just one week since I started. The spatial cognition project is to reconstruct the scene. It is 3D reconstruction and 3D understanding.

Congratulations on the new position. I know you have been at ETH for the last several years. What did you do there?

I was a postdoc for CVG, Computer Vision and Geometry Group, for one and a half years with Marc Pollefeys. There I was working on 3D and super-resolving the appearance of 3D models. We extended my previous model-based approach. We have a paper here. We studied how to use deep learning techniques to super-resolve the appearance of 3D models.

You were not born in Zurich. Can you tell us more about where you come from?

I'm Greek. I grew up on an island, Kalymnos. I finished school there, and then I moved to enter university to finish my first master's in the electrical engineering department in Thessaloniki in Greece. I worked for one more year in a research institute in Greece. Then I decided to continue and go abroad. I visited Lausanne. I did another master's in the computer science department. In Lausanne, I tried to expand my research activities in computer vision. I was also at Idiap in Martigny, where I joined the social computing group.

Tell me something about Kalymnos. Make us dream!

It's a small island. It's not touristy at all. It's really beautiful with small, rocky beaches.

Do you still have family there?

Yes, my family still lives there. I grew up there so I try to go often.

What is special about Kalymnos?

It's famous for the natural sponges. Now it's pretty famous for rock climbing. We have many tourists, more alternative tourists, coming.

I have a special affection for the Greek Islands. You decided to pursue a scientific career. At which point in your life did you realize you wanted to study science?

I had my first mentor in Greece when I did my thesis back during my first master's. This teacher actually introduced me to the world of computer vision, teaching me how to do research and motivating me to follow this path.

"I see things like waves"

Did you ever have any doubts in pursuing a career in science?

It's not always easy. This path is challenging. In the end, you feel satisfied when you succeed, when you achieve the goals that you have initially set. Coming from an island, I see things like waves. There are ups and downs. Throughout this career, you have ups and downs. You know it, so you know that somehow you will learn to overcome.

So now are you in an up or a down?

Now, I feel that I'm up.

Where do you hope this up will bring you?

To happiness! [*laughs*]

What do you need to be happy?

Professionally-wise, I like challenges. I like to have new challenges all the time. This is what I have always done professionally.

These challenges bring ups and downs. Sometimes the challenge is too difficult. Wouldn't you prefer to be happy in a more relaxing way with fewer ups and downs?

Yes, but it's this trip that brings me happiness. I enjoy the ups and downs and then finally achieving your goals.

Will you go back to the island to live one day?

I wish my island could give me the opportunity to pursue my professional goals.

Do you plan to go back to Greece one day or your life is somewhere else?

I always say to myself that one day I'll go back, but it's still not the right time right now.

I interviewed many talented Greek women before you and not one of them is in Greece. What does Greece need now to retain the talent that is leaving?

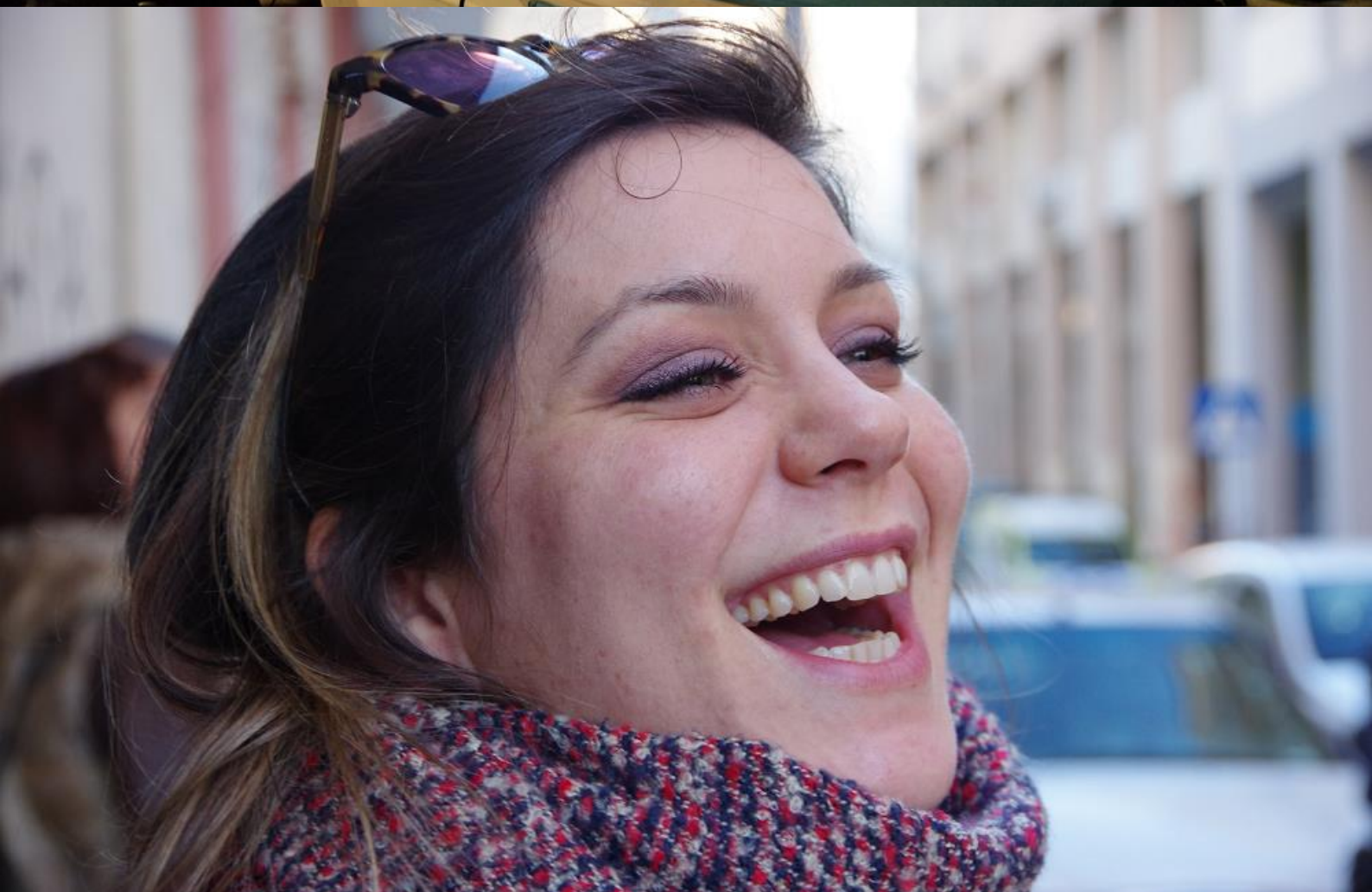
I think things need to change in universities. In universities, you see so many Greeks abroad. We get the knowledge that is needed to pursue research. That's why there are so many Greeks abroad that have wonderful careers. Even though Greek universities don't have the best infrastructure, but we get the basic knowledge. We get the basis that allows us to grow.

Why did you choose IBM?

It's a great place to do research.

What is the most interesting lesson that you have learned?

Difficult question! There were so many. My parents told me to never give up, to always try to accept new challenges and set new goals.



Vagia Tsiminaki

You really never give up? That's very difficult!

You can reformulate your goals. Life is challenging. We change. Always try to do what you think at this moment will make you happy.

What at this moment makes you happy?

I just joined IBM Research. There are some goals I want to achieve professionally.

Can you tell us about your teachers in Greece?

My first mentor during my thesis in the electrical engineering department taught me how to formulate the problem mathematically and find **solutions.**

What is the nicest solution that you have solved so far? I'm sure you have solved many.

In general, when there is a problem, when I formulate it mathematically, I try to solve it. When you actually verify that it works, this makes me happy. When the mathematical model that you have introduced to solve your problem holds in the end.

Do you have an example?

The model-based approach for super-resolving the appearance of 3D objects during my PhD was one project where I followed this kind of thinking. There was the problem, and I formulated it mathematically. I solved it, and then I saw that it works. It actually works how I was expecting it to work.

I love this answer! Would you like to replicate this success?

Yes!

I'm sure you will. If you hadn't been a scientist, what would you have been?

I also like sports. I also used to play piano. At some point, when you need to make some decisions to focus the studies, at least in Greece, we have to give up some of the activities. This is how it works. Maybe I would have continued with piano and become a piano teacher. Or a concert pianist. You never know! I like setting high goals.

What sport did you do?

I was running. To be honest, lately I have started running again. I have done some long distance, like half marathon…

Are you below 2 hours?

No, 2 hours and 20 minutes

So I am half hour faster than you.

Congratulations! Full respect!

Well, long distance running is for old people. You arrive to maturity later than with short distance running.

I hope that I will one day achieve your time.

What do you like about running?

It's like meditation for me. It's time to think, to release the tension, and to isolate myself a bit from life.

It gives you a chance to relax a little bit.

Exactly.

It's funny that people do things which makes them tired in order to relax.

In my case, I want to run to release energy and tension, and to get some time for myself.

What is the next challenge you will set for yourself?

To run a marathon! [*laughs*] Not just any marathon! A marathon in Athens!

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by Ralph Anzarouth

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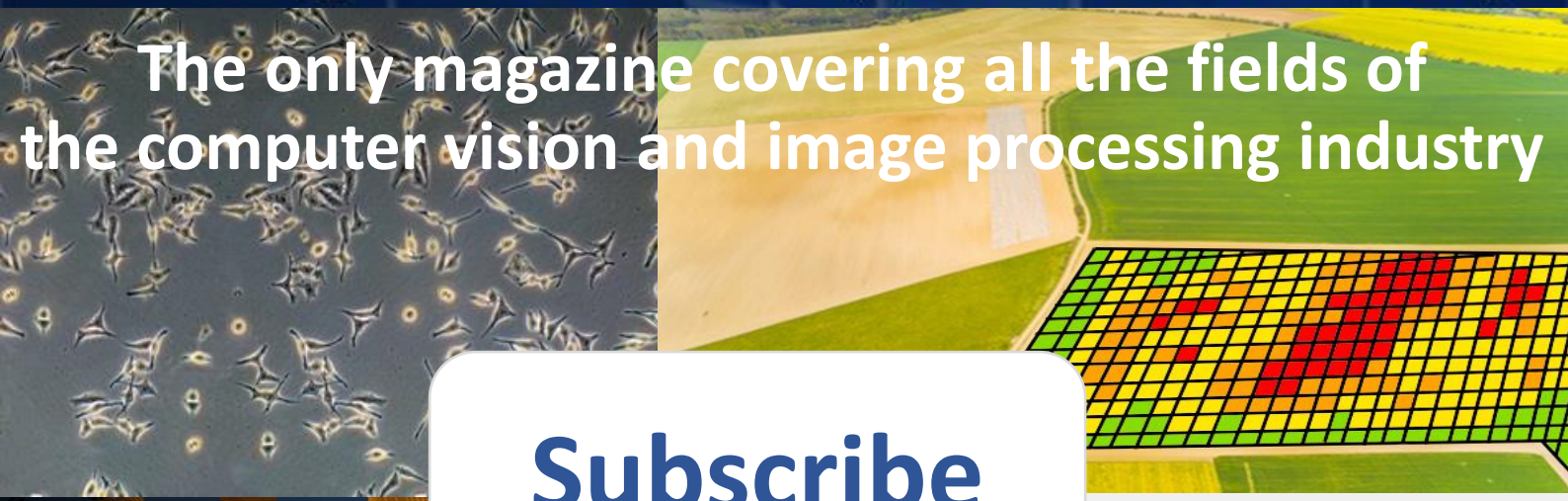

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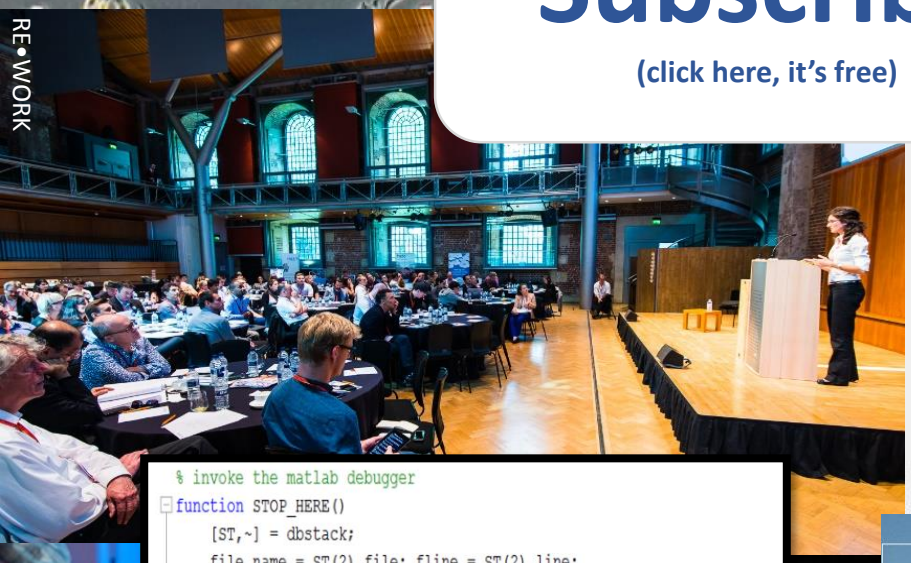
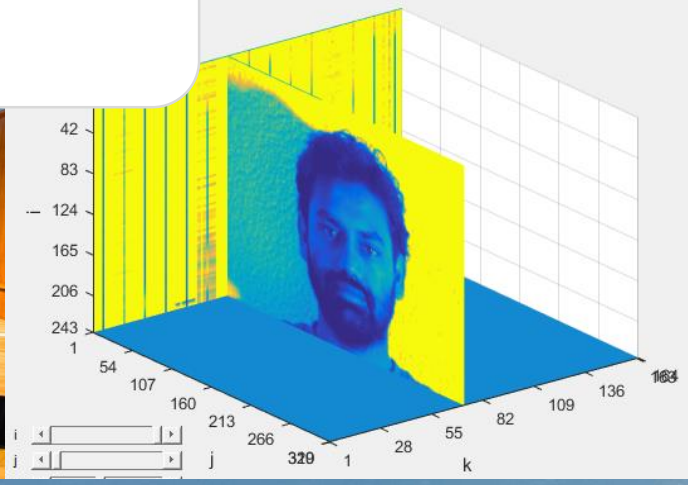
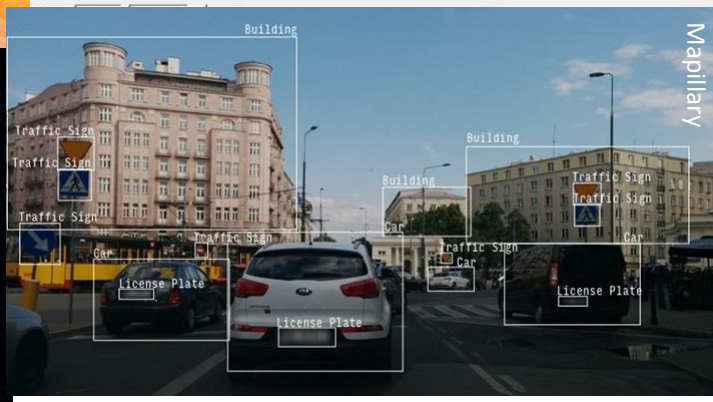
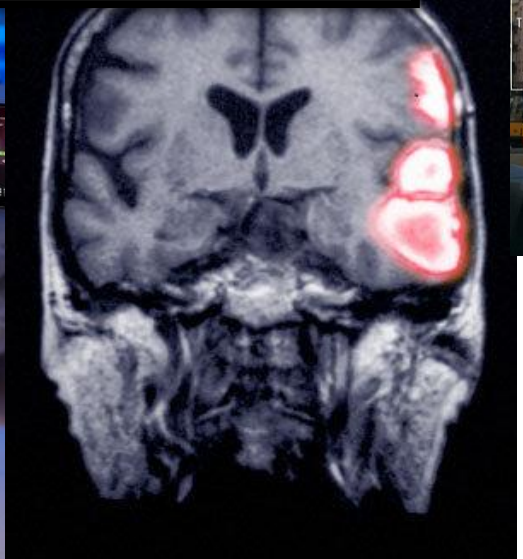





```
% invoke the matlab debugger
function STOP_HERE()
    [ST,~] = dbstack;
    file_name = ST(2).file; fline = ST(2).line;
    stop_str = ['dbstop in ' file_name ' at ' num2str(fline+1)];
    eval(stop_str)
```





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