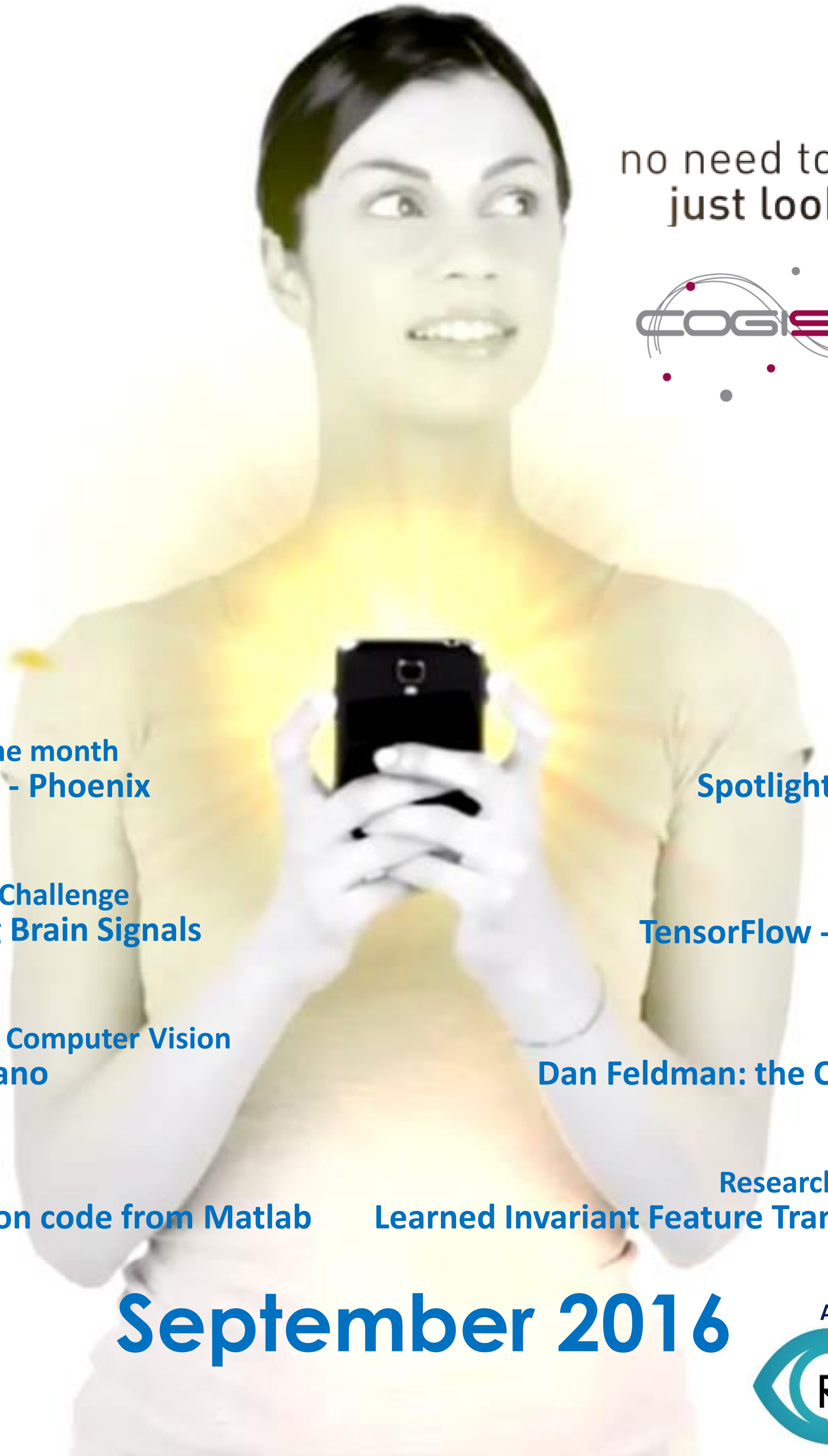
Computer Vision News

The magazine of the algorithm community



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Cogisen

Are our eyes going to be the most powerful of our organs? That might happen with **gaze tracking**, one of the hottest issues in computer vision. A very much talked about start-up in the field is Italian-based and European-funded **Cogisen**, headed by **Christiaan Erik Rijnders**. Trained as an aerospace engineer, Rijnders later worked for the **Ferrari Formula 1 team**, when they were dominating with **Michael Schumacher**. With Ferrari, Rijnders developed simulations and simulators. He was also a technical reference at the circuits.

In those years, simulations were very different from today, when a simulation engineer opens up a software package and puts in parameters. Back then, they had to develop the simulations and the simulators by themselves. It was nonlinear and transient cross physics and Rijnders explains how they were very difficult to model.

He came to the conclusion that engineering needed to make a change when it came to what could be modeled. At a certain point, he started modeling algorithms which he considered necessary, taking the ideas from computational neuroscience, while the actual model itself is inspired by biology. He developed it trying to model what our **visual cortex** impressively does, when it preprocesses before our consciousness, solving signal to noise problems and recognizing single photons.

Cogisen CEO Christiaan Erik Rijnders controlling a smartphone with gaze tracking from a 2m distance

Rijnders found that on the level of neurons, our brain develops models like the chair and table in the first years of our lives: our consciousness doesn't process all of the single photons. Instead, our consciousness stores these models for faster recognition and processes models that have been recognized by our visual cortex. Then we make a conscious model out of this. That's the inspiration behind his idea.

He soon realized that computer vision would need **much more refined algorithms**. As an engineer, his philosophy is that the underlying data has to be as good as possible. Not only that, but you should give the engineers a model that they can understand. That is how Cogisen is becoming very relevant in areas like **machine learning and deep learning**, which are becoming very effective but are still limited by the underlying data.

"The movements of the iris don't even register in pixels if one is standing one meter from the camera"

Here comes the idea of gaze tracking, one of Cogisen's applications in computer vision: you can't just provide a deep learning model of many faces with their eyes moving. First of all, you must have a relevant model of the eyes moving. Secondly, you have to be able to do things sparsely and in a non-linear way. You have to consider the infinite number of light conditions, the faces, and the points of view to the camera.

Then you consider the fact that the pupil and iris movements are subpixel. The movements of the iris don't even register in pixels if one is standing one meter from the camera. Think about the area on the inside of the eye, the outside of the eye and the irises. You can't measure these movements by counting the pixels unless under perfect conditions. **Instead of counting pixels, Cogisen makes the underlying data much better and creates a model from it**.

With this work, difficult nonlinear problems in industry can find a solution: for example, the detection of distant objects for autonomous vehicles with very few pixels. This could also include gaze tracking interfaces for people standing meters away from the video (see the demo) as well as adaptive video compression where it is difficult to get a good model of visual saliency.

Currently, the most advanced solutions in image processing need heavy GPU use. If you look at what they are doing, such as the cloud image processing or image processing for autonomous vehicles, it is extremely advanced and computationally intensive. This cannot be the solution for the real needs of the industry which is **Internet of Things**. We will have billions of devices for which such a huge amount of GPU usage is out of question.

That really goes back to **the core of image processing**. An image is defined by positional data which are the indexes in the image or, in other words, counting pixels. The image itself is defined by many sinusoidal contrasts. Put lots of sinusoidal contrasts together, and you get your complex image of clouds and mountains.

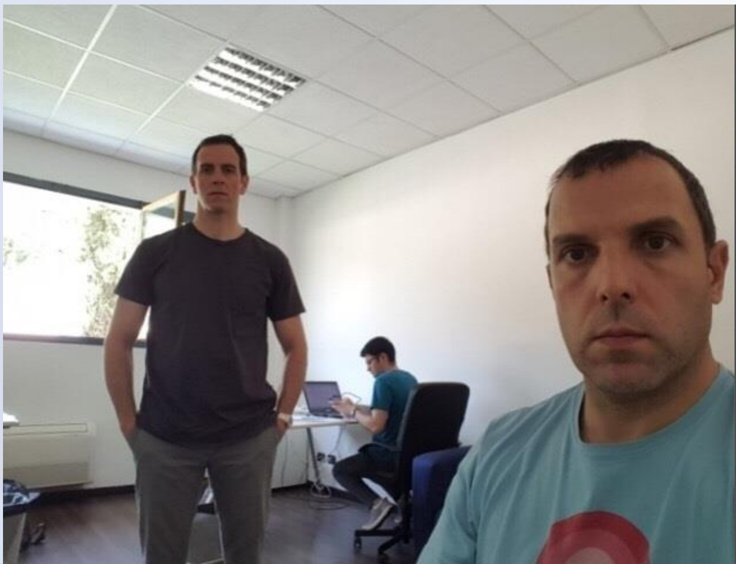
That comes from the theory books saying that the sinusoidal contrasts in the frequency domain become an index position. What people always forget is that these theory books are showing you magnitude. With magnitude, you've lost the information to go back to the spatial domain.

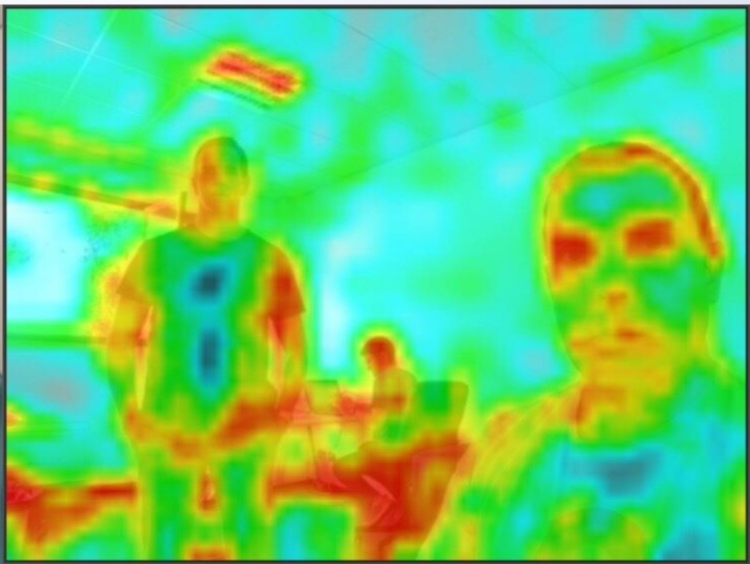
What actually is happening is the opposite of the spatial domain. You have the positional data and the movement data in the frequency domain defined as sinusoidal contrasts. You need those two things. You need the positional data with the sinusoidal contrasts. You also need your indexes or the image itself to go back again to the spatial domain.

If you have the ability to recognize positional data like shapes and movements in the frequency domain, you have something which is much faster and more robust. It manages to model much more complex things because **you're not counting pixels anymore**. You're really looking at changes in information.

Think of it from the point of view of **gaze tracking**. Imagine having a gaze tracking solution in which you are not counting pixels around the irises and around the edges of the eyes. You're simply looking at the change of information as the eyes move. Using the change of information in the movement data in the frequency domain, you have something much more solid and robust which needs less data. Plus you have something which is a model.

That is what is able to capture much more difficult processes in a model. Therefore, **Cogisen**'s vision is to improve the underlying data for industry, allowing all of the deep learning and machine learning methods to reach a better performance. Not only that, if you work like this in the frequency domain, there is much less data required to do learning and training. You won't have this incredible need for GPU acceleration. In this way, you also have the solution for the **Internet of Things**.





We asked Rijnders about the algorithm techniques which are most suited to solve these problems. In his view, you cannot use the traditional methods of algorithms such as DCT or FFT. There are lots of problems with aliasing, periodic data repeating, how to normalize this data, how to make the high frequency data relevant, or how to avoid an input that is a power of 2. To solve all of these things, they converted differently to the frequency domain.

Rijnders and his team worked for two years to create their tool chain and platform. Last summer they started to go often to **the Silicon Valley** and ask the industry what their problems were. Obviously, they have a lot of things that need to be solved and reportedly reception was very good. They clearly want to specialize in quickly creating new solutions for the industry (during the initial phase of Cogisen, they also worked with a Formula 1 racing team): basically, **being asked to invent technology and quickly come back with solutions**.

Now they concentrate mostly on customers in Silicon Valley, who ask them to create technology in an accelerated way using their platform to solve problems they have. Up until now, Rijnders claims there hasn't really been a problem that they haven't been able to solve for Silicon Valley.

Now that they have the structure to do an accelerated type of prototyping for the invention of new technologies, their next step is to provide a product technology, not just an accelerated prototyping for new technologies. They want to open an office in the United States (in the Silicon Valley), close to the customers. Secondly, they would like to have the structure to push these new technologies forward to real products in an accelerated fashion. The time is probably coming for them to do series B funding with an American investor or, even better, with an industrial partner who will help raise their app **Sencogi** to the next level.

"At Ferrari, everyone was 100% open!"

I asked Rijnders if his work at **Ferrari** had any influence on his management style at Cogisen. His first hand testimony of the great years of the **Italian Scuderia** deserve to be told in first person. So here is his reply:

*"I have to say that, when I was at Ferrari, it was really a dream team with **Ross Brawn, Jean Todt, Marco Fainello**. We had a top team. Everyone's opinion was respected. The information flow was open. Everyone knew what the others were up to, but nobody interfered with the work of the other. If you were an electronics expert, you needed to know what was happening with the tires. If you were a tire expert, you needed to know what was happening in aerodynamics. If you were in aerodynamics, you needed to know what was happening in the chassis. Everyone would know what the others were up to, but nobody would interfere with their work.*

*People were not afraid to share information. Often, if the work culture is not correct, then people will not share information to protect themselves and their work from future problems or politics. There was none of this. **Everyone was 100% open**.*

“There was a culture in which taking risks with technology was encouraged”

On top of this, there was a culture in which taking risks with technology was encouraged. If it didn’t work out, it was fine. Nobody was punished for it. Another thing that was really fantastic was that there was really no politics. Jean Todt really encouraged that and all the managers were protected, feeling that taking risks with technology was accepted and encouraged. All the engineers felt that they had a voice, they were listened to and appreciated by the team. It was really an incredible work environment for engineering and stability. Ferrari was incredibly strong in those years.

*During that time, I woke up and couldn’t wait to get to work because it was a fantastic work environment. It was really a joy to work for people like **Rory Byrne**. Everyone had **so much confidence in what the other person was doing** that you could completely concentrate on your own work.*

I’ve followed many of these guidelines at Cogisen. I really tried to recreate the management style that makes Ferrari such a fun place to work. We have a lot of stability at Cogisen with many top experts. The fact that they all enjoy working with us shows that we have a very good work environment.”

“Michael is a very sensitive, funny, and generous person”

Rijnders also has sweet souvenirs of **Michael Schumacher**, which are quite off-topic here, but too precious to leave unpublished:

“Michael was also special in those years. People thought of him as a robot or super human. This was something that the press created, and Michael was very happy to play along. He always knew how to speak Italian, but he never spoke Italian in front of the press because he didn’t want to show weaknesses. Of course, if your opponents think that you are super human, you’re already halfway to winning the race. Psychologically, I think that his trick worked. In reality, [Rijnders and I decide that we should speak of Schumacher in the present tense] ***Michael is a very sensitive, funny, and generous person**.”*