

**VISUAL  
SWEDEN**

**EUROPE'S** most **ATTRACTIVE**  
**ENVIRONMENT** for **INNOVATION**  
in **VISUALIZATION** and **IMAGE ANALYSIS**



## Welcome to Visual Sweden

Visual Sweden is an initiative based in Östergötland, Sweden, and its object is to promote innovation and regional growth in the field of visualization and image analysis. No other region in Sweden can match the group of visualization and image analysis specialists that Visual Sweden can muster. The majority are companies that develop new solutions in this field. Key players are Region Östergötland, Linköping Municipality, Norrköping Municipality, Linköping University, several governmental institutions and agencies such as the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish National Forensic Centre (NFC), and the Swedish Defence Research Agency (FOI), as well as nearly a hundred small, medium-sized, and large companies.

The core of our activities is based on innovation in and collaboration on visualization and image analysis. Visual Sweden has a wide network of contacts among trade and industry, public authorities, and higher education institutions, where we help find common denominators. Sometimes this concerns meetings, matchmaking, and visualization – other times it involves joint opportunities via public procurement procedures, invitations to tender, and innovation grants. We open the door for those looking for development and innovation in this field!





## A world-leading visualization center

Anders Ynnerman is the overall scientific leader for Visual Sweden and specifically in the field of visualization. He also work as a professor of Scientific Visualization at LiU and Consortium Director of Visualization Center C. He believes that the Linköping-Norrköping Region's strong position in visualization will become increasingly important. And they owe a lot to the world of academia.

– The visualization research conducted at Campus Norrköping's Department of Media and Information Technology is among the best in the world, and, with 100 employees, it constitutes the biggest research initiative in this field in Europe. Norrköping Visualization Center as a whole is unique globally with the consortium that conducts research, he says.

### **What does it mean to a region of Linköping-Norrköping's size to have this type of research position?**

– The profile area will play an increasingly important role in the future. In the national and global competition for resources (not least in higher education institutions), specialization and pooling of resources in areas of strength represent a survival strategy.

### **Are there any key factors that are especially important to highlight when discussing the conditions for creating a good innovation environment in visualization?**

– I would here like to emphasize the link to our study programs. I usually say that if we had started

a visualization center 20 years ago, we would've failed. Back then, the competence needed didn't exist in the region. Now, 20 years later, this competence exists through LiU's education of students who have chosen to remain in the region and contribute to the development of research and the business sector. Almost daily, I encounter alumni who were enrolled in our study programs and who now hold leading positions in the region's business sector. I believe that the visualization competence that they bring with them from their study programs is one of the most important factors. Otherwise, the same key factors apply to innovation as to other areas: skills, funding and people with drive.

### **What future challenges and opportunities do you see in the visualization field in the future?**

– We've positioned ourselves well in relation to the disruptive changes that we're seeing with digitalization and machine intelligence as drivers. We have the technology that places man at the center of that development and this is one of the main challenges going forward. Now we need to focus on Visualization as a key technology in Human Centered Technologies.

**“PROFILE AREA WILL PLAY  
AN INCREASINGLY IMPOR-  
TANT ROLE IN THE FUTURE”**





## “The University played a central role”

Robert Forchheimer, Professor Emeritus at Linköping University (LiU), is one of the pioneers in the field of image processing in Linköping and academia. Having joined LiU, then called Linköping Institute of Technology, in 1972, he has not only contributed to the development of the research field, Forchheimer has also founded and run a number of companies, thus contributing to the strong position of this field in the region.

– In the early 1970s, there was no activity in the field of image analysis and processing. Professor Per-Erik Danielsson was interested in this field and was instrumental in hiring Björn Kruse, who started the development of the special image processing computer PICAP.

Gösta Granlund subsequently also joined LiU, and an ever-increasing number of doctoral students became involved in the two image processing groups that were set up. When both these groups spun off companies that were the first to be located in Mjärdevi science park, their activities put Linköping on the map and meant that the region began attracting international attention, he says.

### **What role did you play yourself?**

– As far as my own area was concerned, the incentive was that I saw a need to be able to send images, both moving and still, over the telecommunications network. The applications were available in medicine, but also the newspaper industry was interested in being able quickly to receive footage from dispatched reporters. For example, Swedish newspaper editors

were among the first in the world to receive images in electronic form via a device developed by Hasselblad AB together with the SECTRA spin-off from LiU.

### **How important was Linköping University's role in this development?**

– The University has been a key player. Without LiU's involvement, there wouldn't have been research and development on the scale necessary to get to where we are today. I myself came to Linköping because I was attracted by the opportunity to work in an academic environment with what interested me, and I'm convinced that this was also the case for the key people working there. Unlike many other Swedish colleges and universities, LiTH and LiU had a positive view of collaboration with industry from the outset, which wasn't the norm at all in the early 1970s.

### **What role does Visual Sweden play for the region in the field of visualization and image analysis today?**

– The object of Visual Sweden is to promote innovation and growth. It has a wide network of contacts, and the companies I support benefit greatly from this. Furthermore, Visual Sweden helps put focus on our region when it comes to visualization and image processing, which continues to strengthen our brand in this field.

**“THE OBJECT OF VISUAL SWEDEN IS TO PROMOTE INNOVATION AND GROWTH”**



## Unique research opportunities

Ingrid Hotz is Professor in Scientific Visualization. Originally from Germany, she chose to move to Sweden to join the mecca of visualization at Linköping University.

– The conditions to conduct visualization research at Linköping University are fantastic. The research division for media and information technology in Norrköping provides a dynamic inspiring environment by combining a large variety of expertise related to visualization. The embedding in the Visualiseringscenter C with great visualization facilities is a unique set-up. Being a part of Linköping university provides the necessary source for research collaborations which is essential for applied research, Ingrid says.

Ingrid is practicing her research in the area of scientific visualization. The mission of scientific visualization is to solve data analysis problems with the human in the loop. The research ranges from the development of theoretical concepts for data analysis to solving application-specific problems. For her, the choice to work at LiU was obvious.

– Visualization research done in Norrköping is well-known internationally. Seeing the opportunity to contribute to this group immediately sounded interesting to me. Besides the scientific incentives, it was also the beauty of the city with the university buildings in the industrial landscape that seemed to be a nice place to work and live.

**"VISUALIZATION RESEARCH DONE IN NORRKÖPING IS WELL-KNOWN INTERNATIONALLY"**

## With good access to competence

The virtual reality company Voysys is based in Norrköping and has impressive credentials, including having assisted CNN in the live broadcast of a solar eclipse, filmed with 360-degree cameras in seven different locations in the United States. The company has subsequently proceeded with the development of a software that allows remote control of vehicles, machines, and robots over public networks such as 4G and 5G. Being based in Norrköping has helped the company move forward, says Magnus Persson, CEO of Voysys.

– We find that we have good access to competence, and the competition is not as sharp as in the big cities. We've also

established a number of collaborations with other companies in similar fields of technology, and acquired some visibility thanks to the region's focus on visualization.

**As an entrepreneur, what would you say are the most important factors to ensure further strengthening of the region in visualization?**

– Study programs with strong focus on software development aimed at visualization. Supporting current entrepreneurs in the field so that they succeed – they will then become success stories that can attract more entrepreneurs to venture to invest in this.





## “Here win-win solutions are created”

The Center for Medical Image Science and Visualization (CMIV) conducts interdisciplinary frontline research in the borderland between medicine/biology and technology to solve the clinical issues of tomorrow. Anders Persson, Professor in Medical Image Science at Linköping University, is the director of the center, and he believes that the breadth that exists in higher education institutions and the business sector favors medical visualization.

– For medical visualization to benefit patients, this requires that the whole chain from idea and research to innovation is optimized in all parts. The right problem must be presented to the respective researchers and the right medical data must form the basis for the research. If you solve the right problem, there will always be an opportunity to sell

this solution to the healthcare sector.

The wide competence needed for medical visualization to really make a difference in healthcare is available in the Linköping-Norrköping Region through a unique close collaboration between companies, healthcare services, and universities. Here, win-win solutions are created in which everyone wins from the activities performed in this socially important field.

### **What do you think is needed to develop this field further?**

– To scale up the activities, additional funds need to be allocated, first and foremost by employing more research engineers and research nurses who can reduce the bottlenecks that are currently preventing optimal utilization of the technology in clinical everyday life.

**“TO SCALE UP THE ACTIVITIES, ADDITIONAL FUNDS NEED TO BE ALLOCATED...”**



## “In demand both locally and internationally”

Michael Felsberg is Professor in Computer Vision at LiU. His research covers a wide range in artificial visual systems, such as three-dimensional computer vision, computational photography, object detection, and robotic vision. Felsberg sees enormous potential in the region.

– There are unique prerequisites here regarding the academic area of competence. Linköping University has cutting-edge competence in both visualization and image analysis, both nationally and internationally, and there is longstanding collaboration between the fields,” he says.

This close collaboration has led to exciting projects. For example, Felsberg, together with Jonas Unger,

Professor of Media and Information Technology, and several other researchers at LiU have been awarded one of WASP’s\* nine excellence projects. But the advantages of the region do not end there, according to Felsberg.

– There is also unique infrastructure with the Visualization Center in Norrköping and Visionen in Linköping.

The local industry also has cutting-edge competence in the field, such as Maxar, SICK IVP, Termisk systemteknik, and others. Academic research and industrial research collaborate in many different ways, e.g. thesis and degree projects, student projects, commissioned research, Vinnova projects, and recruitment of students from the study programs in visualization and image analysis is in demand both locally and internationally.

**“... THE LOCAL INDUSTRY  
HAS CUTTING-EDGE  
COMPETENCE IN THE FIELD...”**

\*Wallenberg AI, Autonomous Systems and Software Program, coordinated by Linköping University.  
The total budget is SEK 5.5 billion (> EUR 500 million)

# Innovation and collaboration

Visual Sweden works based on a vision to collect a wide network of contacts spanning trade and industry, public authorities, and higher education institutions. The Linköping-Norrköping Region is a center for visualization, and we proudly see how companies and authorities together help the development forwards.



Isabelle Hachette is the CEO of Interspectral, a company that visualizes and analyzes complex digital twins to make it possible easily to interact and understand complex data. Interspectral provides 3D visualization and data fusion to capture and analyze the world in 3D, also in VR and AR applications. The company operates globally and focuses on two main business areas: interactive 3D experiences for museums and experience centers and industrial applications for additive manufacturing in Industry 4.0.

– Visual Sweden has meant that we have gained access to opportunities to test and develop different parts of our existing products or completely new products in collaboration with large and new players. For us, a project with Siemens resulted in a brand-new product in additive manufacturing that we have launched on the market. There is great potential in this field. We're also involved in

## “Visualization – a regional area of strength”

a project right now where we're exploring AR/VR with the goal being to include this in our coming products and development projects.

### **How important is it to have a unifying player like Visual Sweden in the region?**

– As visualization is a regional area of strength to which high priority is given, having a unifying player with expertise, network, coordination, and competence is a key factor. Without a unifying organization, the opportunities for driving both growth and development are small and there is rarely time for either large companies or small companies to sound out the possibility of new collaborations on their own. In this respect, Visual Sweden thus means validation and quality assurance where the player itself is a guarantor of security and competence, which means that the parties involved dare enter into projects and test new approaches.





## “Linköping ticked all the boxes”

The image analysis company Axis moved part of its operations to Linköping in order to secure the competence of tomorrow. Henrik Kurelid, R&D Director in Linköping, is pleased with the expansion.

– There were a number of alternative options. Among the criteria were good communications, easy interaction with the sister site in Lund, good competence supply, a healthy and vibrant local business sector, and technical cutting-edge competence. Linköping ticked all the boxes in a way that other places found it hard to do.

### **What does the future need for labor look like in your area?**

– There is a great need. There is much confidence in Axis’s Linköping office. As we’re seeing continuous and long-term growth in Linköping, during 2020-2021 we built a new office in Linköping in collaboration with the real estate company Sankt Kors where we moved in during November 2021. The building is located in the middle of the vibrant Ebbepark and is completely dedicated to Axis’s operations.

## “VISUAL SWEDEN PROVIDES A WIDE NETWORK, WITH COMMITTED PARTNERS”



## “The development is rapid”

The Swedish National Police Authority benefits greatly from visualization in its work to solve crimes. Lena Klasén, Research Director at the Swedish National Police Authority and Adjunct Professor, Digital Forensics, LiU, says that, for example, they have introduced technology for 3D measurement of crime scenes for documentation, analysis, and visualization of large and complex crime scenes, of which it may be difficult to get a clear overview for various reasons.

– 3D models also make it possible to recreate and visualize the course of events. We’ve also participated in several projects for biometric identification and automated searches for persons, objects, or vehicles in large

data volumes, tested virtual witness visits to crime scenes, and tested hyperspectral sensors for detection of different types of traces at crime scenes,” she says.

### **Visual Sweden works to gather this competence and functions as a unifying player in visualization and image analysis – what benefit can you see from such an initiative?**

– It’s of great importance! The area is broad and is developing at a fast pace, and, as an individual party, it’s very difficult to allocate the resources that would be needed to act on your own. Visual Sweden provides a wide network, with committed partners and where we’ve experienced very rewarding and prestigious collaboration of world-class quality.

# We invest in the future

Securing and supporting future competence in visualization is one of Visual Sweden's most important tasks.

Linköping University definitely plays a central role in this.



## “It keeps your interest high”

Visual Sweden wants to make it as easy as possible for students at Linköping University to collaborate with companies and other organizations in the region to establish important contacts for future thesis and degree projects, jobs, or as a support when starting their own business. Anton Hjert is studying for a Master of Science in Applied Physics and Electrical Engineering at Linköping University and has just moved to Linköping from Solna.

– What I like best about my study program is that you get a solid theoretical education with great variation during the first years after which you can choose to specialize in a wide range of highly interesting master profiles. Combining advanced mathematics and physics with electronics and programming keeps your interest high and boredom to a minimum.

### **Why do you want to work in visualization and image analysis?**

– It really hasn't been an obvious choice all the way, but when choosing a master profile, I realized that programming is something I want to work more with. I've been involved in music for a large part of my life and I love working creatively. It was something I felt I could channel into programming. There are then several reasons why I chose precisely image analysis. Firstly, it provides a supplement to the monotonous elements of programming with visual aspects that stimulate your mind. You quickly see a clear grounding in reality in your work. On the one hand, it is fascinating to work with and program systems to perceive and interpret their surroundings to see which societal aspects can be improved and simplified.

**“YOU QUICKLY SEE A CLEAR  
GROUNDING IN REALITY  
IN YOUR WORK”**



## “Fun and creatively stimulating”

Fanny Olsson graduated in graphic design and communication at Linköping University. A study program that she describes as fun, educational and creative.

– As you get the opportunity to try to create different types of design in different types of projects, the study program is both great fun and creatively stimulating. I like finding exciting ways to communicate a given message. Design is, in fact, a constantly evolving and changing field, and you also have the opportunity to explore this at Linköping University,” she says.

After graduation, Fanny, who is originally from Katrineholm, moved to Kalmar after being offered a job there. The Linköping-Norrköping Region is, however, still an attractive option professionally for her.

– It definitely is! I got a job almost immediately after my graduation, and I then relocated, but I would be lying if I said that I do not occasionally long to return to wonderful Norrköping with the opportunities that exist there!

## “Prepares me well for working life”

One of Linköping University’s central study programs in visualization is the Master of Science in Media Technology and Engineering. Tilda Hylander is enrolled in this program.

– The program gives us students a very broad technical foundation and prepares us well for working life. We learn how to program in many different programming languages and to apply our mathematical skills,” she says.

### **What attracted you to the study program?**

– Media Technology combines technical problem solving with creativeness and gives us the tools to tackle various complex problems, and I like that! During the master programme, we can specialize in, for example, visualization, computer graphics, development of games, publication, or image processing. Together with the knowledge that we acquire during our studies, we also learn how to learn things, which I think will be a great advantage in my working life.

### **What do you find is the most exciting aspect of visualization and image analysis?**

– It’s that there are so many different applications and uses for it. Through image analysis, you can extract meaningful data from images, which can be used for purposes like facial recognition, self-driving cars, and medical treatment. Through visualization, you can illustrate complex systems and contexts to make them easier to understand for certain occupational groups, private individuals, or groups of researchers. With computer graphics combined with visualization, you can create simulation and animations which can be used in games, flight simulators, and even for training tools for surgeons. At Media Technology, we have several courses in these subjects such as scientific visualization, information visualization, image processing and image analysis, as well as VR courses. From these courses, we acquire various tools and skills which can be used for an infinite number of applications!



**“THROUGH  
VISUALIZATION,  
YOU CAN  
ILLUSTRATE  
COMPLEX SYSTEMS”**





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# The role of politics

As a strong visualization region in Sweden and Europe, Linköping and Norrköping is engaged in close cooperation with policy makers. Working together and clarifying established success factors and future needs are essential aspects in continuing to develop.

## “Creates jobs, both today and in the future”

Olle Vikmång (S), 1st Vice Chair of the Municipal Council in Norrköping, is very pleased with the strong position the region has in visualization and image analysis. This creates great opportunities for the inhabitants, he says.

– It means that we have a very strong growth area in the region that creates jobs both today and in the future. Visualization and image analysis is an industry that is developing strongly in itself and that has a great potential to

develop in many different industries in the future, he says.

**Today, the region is a world leader, how can policy makers help facilitate the further development?**

– As politicians and public players, we must maintain the actions we have initiated and show long-term commitment. We also need to see the development opportunities that exist in our own activities so that, through visualization, we can further strengthen the quality of our welfare services.



## “Having several world-leading companies means a lot”

Niklas Borg (M) is Chair of the Municipal Council in Linköping. He agrees with his colleague Olle Vikmång that the region's strong position is positive at many levels.

– We have several world-leading companies, large and small, in Linköping that operate on a global market. In turn, these companies attract other companies to establish themselves here. At the same time, LiU conducts strong research in visualization, image processing, and image analysis that contributes to the formation of new innovative companies. In total, this creates new jobs and continued technological development and innovation. Visualization and image analysis are also an important

partner technology for AI to make it easier to analyze and understand large data volumes. The company Vricon/Maxar is an excellent example of this successful cross-fertilization.

**How can policy makers help the region grow further?**

– By contributing to having a strong incubator and an active Science Park that can offer support to entrepreneurs, run development projects, and create meeting places for business clusters. But also by securing strategic cooperation with LiU as well as with other financiers and stakeholders in the region.

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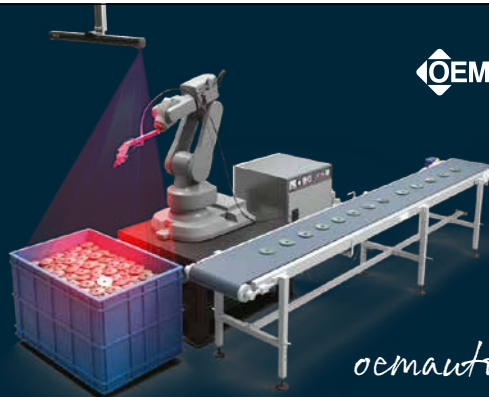
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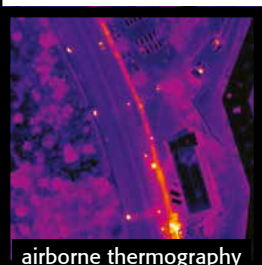
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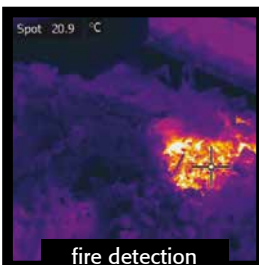
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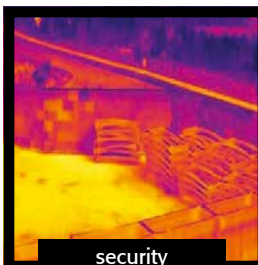
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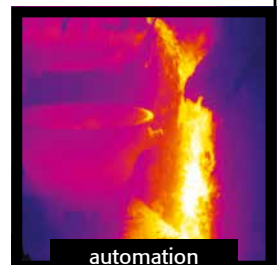
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– Erfarna ingenjörer inom AI, bildanalys och visualisering

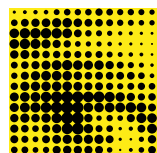
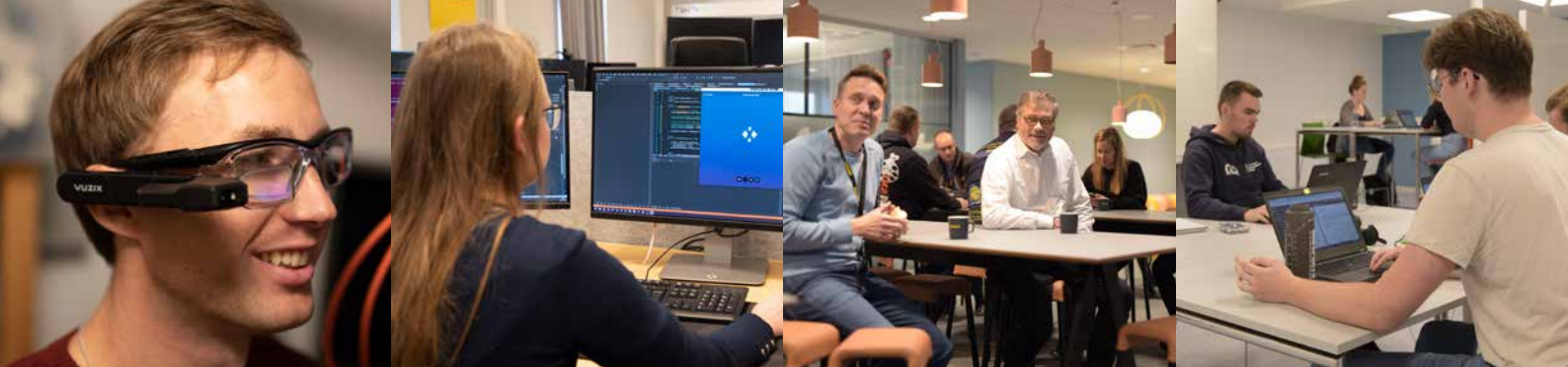
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