EVS machine-learning and computer vision Internships 2023-2024

3D Stadium and Players Modelling for Photo-Realistic Data Generation

Keywords: photorealistic rendering, digital twin, dataset generation,

Sport plays a significant part in the entertainment industry. Therefore, it provides many opportunities for innovation and new technologies. One can think of several applications to ease EVS operators' work and improve live production workflows. Since off-the-shelf methods are not always well suited for sports content, these applications require specializing and solving fundamental computer vision problems such as camera calibration, player detection, player tracking, complex scene understanding, action detection, …

Training novel methods or specializing and improving existing ones requires a lot of annotated data. The usual way to get annotated data is to resort to manual image annotations. This process is cumbersome, requires a lot of time and sometimes needs complex tools to remain efficient and impactful. Another way to get perfectly annotated training data for many image analysis tasks is to resort to computer generated graphics to create photorealistic images and their associated annotations.

In this context, the goal of this internship is to leverage the existing stadium and player models in Unreal Engine in order to construct a python tool that allows to create photo-realistic images with associated targets for object segmentation, player tracking, depth maps generation, soccer pitch markings segmentation etc.

For the development of this tool, you will be included in the Innovation team, and you will be closely supervised by a member of the Innovation team. The ideal candidate for this internship already has some experience with Unreal Engine and python.

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IQA-Based Data Filtering for Deep Learning Model Training

Keywords: data centric ML, Image quality, data filtering, preprocessing, deep learning

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Measuring image quality is of fundamental importance for great content creation and storytelling. Image quality assessment (IQA) aims to determine the level of "suitability" of an image for a given context. It can be based on the subtle combination of objective (sharpness level, contrast, presence of distortion, good exposure, …) and/or subjective (based on user ratings and publicly available datasets) methods.

Once a large amount of video content is available, the benefits of rating and ranking images based on quality metrics become obvious and crucial for an improved user experience. Also, for more specific tasks (such as super resolution, deblurring, denoising, frame interpolation, …), we suspect bad quality images found in public datasets to be detrimental for training top-notch DNN models. In this context, we would like to investigate IQA methods to make sure the output of our various image restoration models is the best possible.

In this context, you will be responsible for investigating current state of the art automatic IQA methods. You will apply and extend the best candidate approach to sports and live broadcast content. During this internship you will become a part of the innovation team at EVS, and your work will take place under the supervision of a computer vision engineer. You will investigate, implement, and evaluate various strategies. You'll learn how to train DNN on a dedicated cluster on large amount of data.

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Content Generation beyond Camera Capture with Diffusion-based Methods

Keywords: diffusion models, inpainting, outpainting, super resolution, generative models

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Inspired by non-equilibrium thermodynamics, diffusion models (DMs) are gaining significant popularity. Compared to GANs, these generative models are more stable to train and are producing image of greater quality. The growing amount of ongoing research demonstrates the power of such model in various applications.

Notably, diffusion models are being used to artificially upscale images as well as for in/out painting images. Increasing the spatial resolution and/or changing the aspect ratio of video content in the context of sports broadcasting can help to create a more engaging and immersive experience for spectators and improve the overall viewer experience. We believe that diffusion models can help in generating photorealistic details in images that are not originally captured by the camera sensors.

In this context, you will be responsible for investigating current state of the art diffusion model techniques. You will apply and extend the best candidate approach to sports and live broadcast content. During this internship you will become a part of the innovation team at EVS, and your work will take place under the supervision of a computer vision engineer. You will investigate, implement, and evaluate various strategies. You'll learn how to train DNN on a dedicated cluster on large amount of data.

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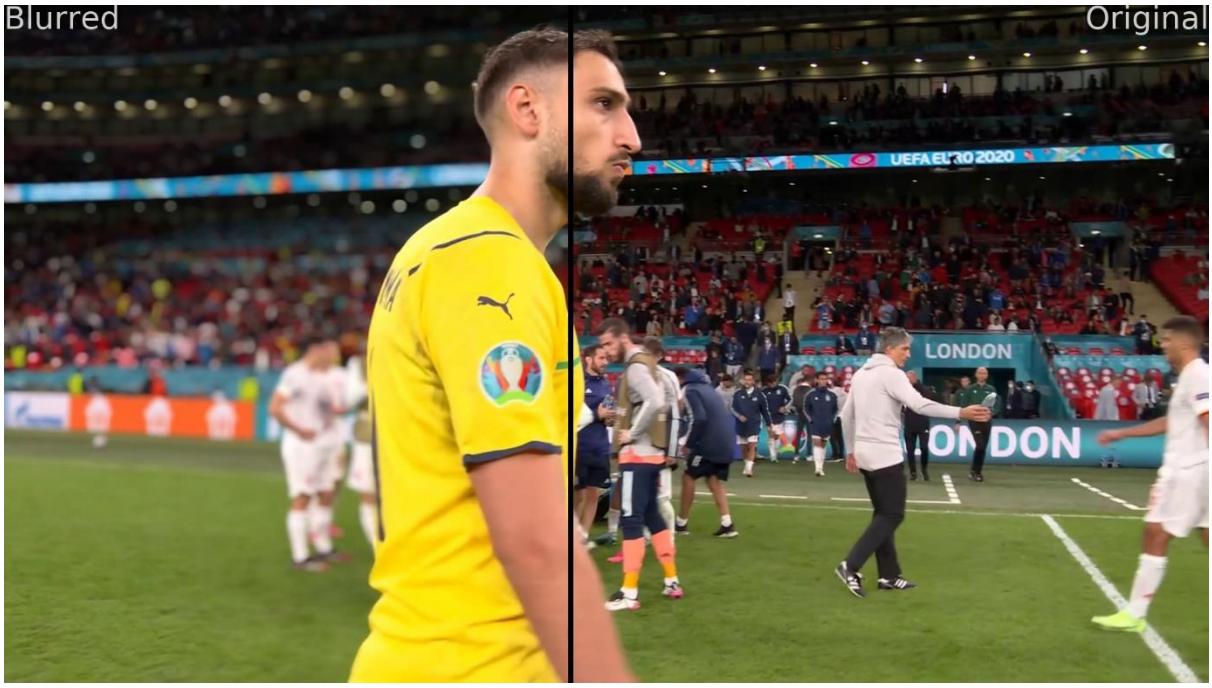
Bokeh Effect Synthesis with End-to-End Methods

Keywords: Bokeh, cinematic effect, depth-of-field

Cinema cameras are more and more used in a live sport broadcast context to generate the so-called bokeh effect. This effect is what is obtained when a short depth-of-field camera is used to highlight a specific subject by contrast with the background which presents an enjoyable out-of-focus blur.

These cameras and their lenses are however cumbersome to integrate in a live production, on top of being very expensive. This is why there is a strong benefit to generate this effect synthetically, based on regular cameras. EVS is already working on its own bottom-up method but would like to investigate end-to-end methods.

The intern will thus be responsible for reviewing the literature about depth-of-field, cinematic or bokeh effect synthesis. He will test available codes, implement the most promising methods in PyTorch and train them. Moreover, the intern will compare the different methods both quantitatively on public benchmarks and qualitatively on relevant videos in order to choose the best method and hyperparameters for EVS. The intern will need to be able to work quite autonomously, while receiving regular guidance and relevant help from members of the Innovation team.



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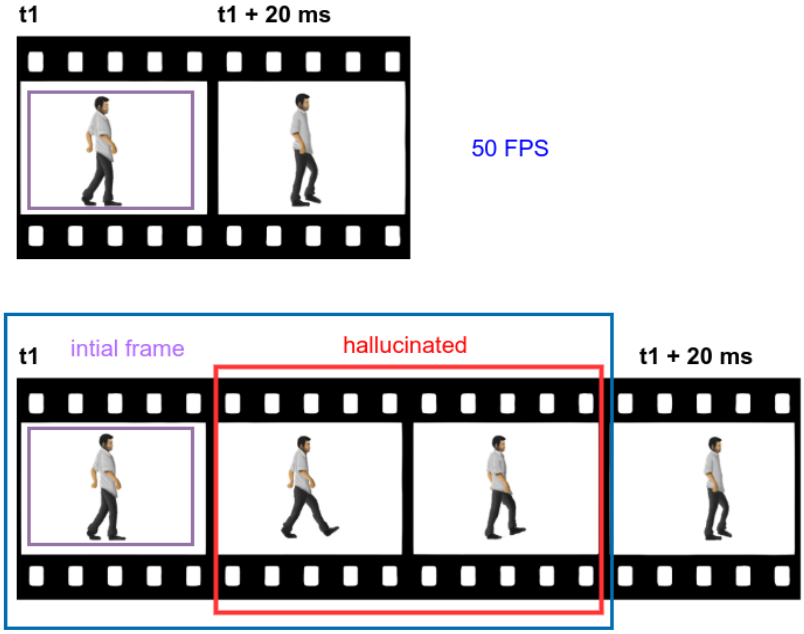
Video Frame Interpolation for Sports Content

Keywords: Slow-motion, replays, frame interpolation

Live slow-motion replays in sports broadcast are one of the most compelling ways for the spectator to relive and better understand sports actions, as well as living the emotion with the athletes. One of the ways to obtain slow motion is to use high frame-rate cameras. These capture at least 150 frames per second and as such allow to playout the frames at 50 frames per second, giving a 3x slow-motion while having a smooth video. These cameras are however expensive and as such cannot be placed everywhere in the sports event, especially in places that could damage them such as a sports car.

As a solution to this problem, EVS provides XtraMotion, its solution to interpolate frames and produce smooth replays from standard 50 fps cameras, based on an in-house algorithm which provides very satisfactory results. There are however still some failure cases and this is why we would like to explore new methods for video frame interpolation, which is an active research area.

The intern will thus be responsible for reviewing the video frame interpolation literature, testing available codes, implement the most promising methods in PyTorch and train them on EVS data. A dataset of slow motion videos will be provided to explore the adaptability of these methods on sports content. Moreover, the intern will compare the different methods both quantitatively on public and EVS benchmarks and qualitatively on relevant videos in order to choose the best method and hyperparameters for EVS. The intern will need to be able to work quite autonomously, while receiving regular guidance and relevant help from members of the Innovation team.



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EVS machine-learning and computer vision Internships 2023-2024

Novel view synthesis with NeRF

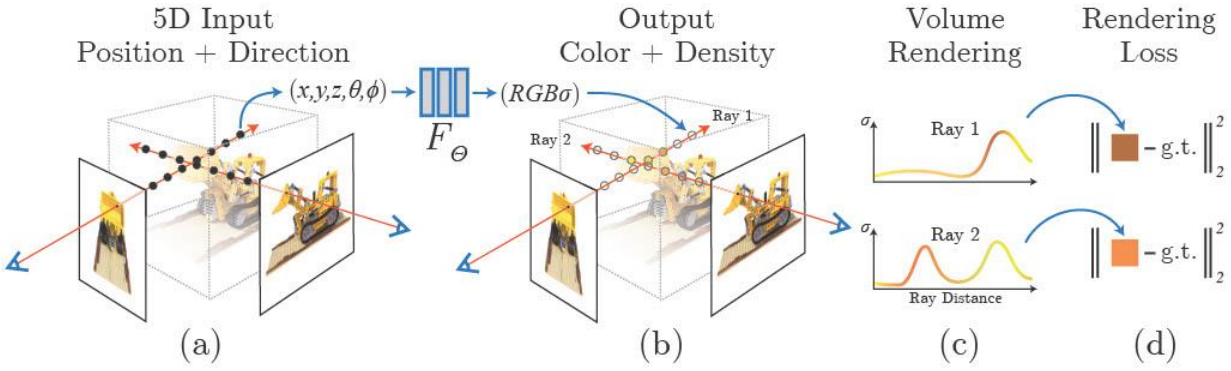
Keywords: NeRF, viewpoint synthesis, photorealist rendering

Neural Radiance Fields (NeRF) is a rapidly evolving field in computer vision, and in a few years from now, you will have the ability to watch sports replay from any viewpoint. The objective of the internship is to investigate the use of NeRF for viewpoint synthesis under real-world conditions, such as dynamic environments and limited camera perspectives, while adhering to challenging requirements such as achieving photo-realism in real-time.

As a member of a collaborative team effort, you will contribute to the development of a cutting-edge pipeline, spanning from camera setup to 3D model export and integration with game engines such as Unreal Engine. You will be assigned to a specific segment of the pipeline based on your personal preferences and will be tasked with investigating the latest developments in the field to push the boundaries of what is currently achievable.

Under the guidance of a computer vision engineer, you will be responsible for reviewing relevant literature, selecting the most appropriate methods, testing and validating their effectiveness. You will be working in collaboration with fellow interns and computer engineers to integrate your findings into the project pipeline.

The ideal candidate should possess knowledge in Deep Learning and be acquainted with the PyTorch framework. They should have prior experience in developing machine learning models and demonstrate an interest in both 3D reconstruction and computer-generated animations.



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EVS machine-learning and computer vision Internships 2023-2024

Speech Recognition and Natural Language Understanding for Broadcast Videos

Keywords: speech analysis, NLP, metadata generation

The broadcast industry plays a crucial role in providing entertainment and information to millions of people around the world through television shows, news programmes and documentaries. However, the vast amount of footage recorded during production is often under-utilized, leaving valuable data inaccessible. This has led to the challenge of efficiently searching for relevant content, which is complicated by the scarcity of tags; a resource only available to top productions that spend money to produce them.

To address this challenge, recent advances in deep learning, particularly in speech recognition, offer a solution through the automatic generation of subtitles that could be used to better index video content. Speech recognition also allows for the detection of commentators' emotions, which might enable better event identification. In addition, state-of-the-art computer vision and natural language understanding techniques can be used to automatically generate video tags and descriptions, enriching databases with relevant metadata.

The goal of this internship is to explore the current state-of-the-art techniques in speech recognition and natural language understanding, identify methods that are optimal for EVS video content by testing them, provide an implementation of a novel method and train it on EVS data using PyTorch. The intern will provide qualitative and quantitative evaluations for this new algorithm. At the end of the internship, the intern will have developed a novel implementation that will enhance the utilization of video content by enabling better detection of events and improving search capabilities.

The intern will have deep learning knowledge and be able to work autonomously with regular guidance and support from members of the innovation team.

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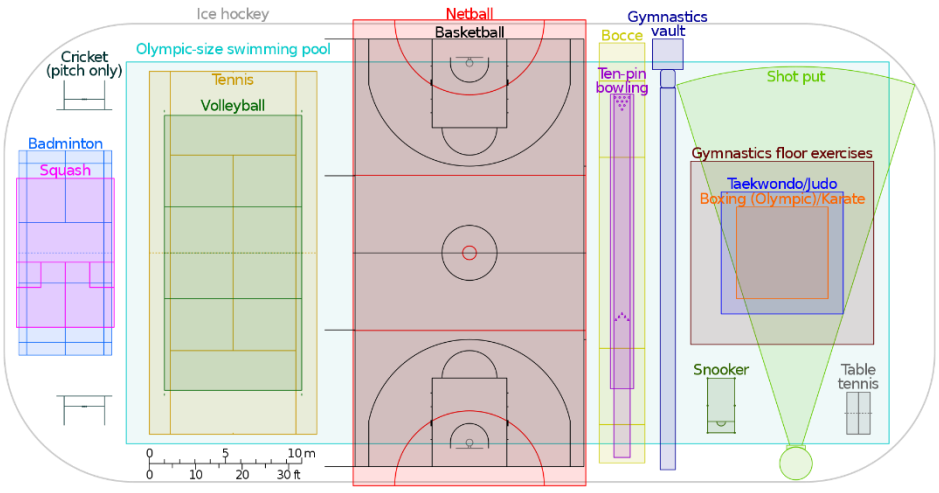
Generic Detection of Sport Pitches in Broadcast Images

Keywords: keypoint detection, geometry, camera calibration

EVS is looking for an intern to join the Innovation team and work on generic detection of sport pitches in broadcast images. Virtual/augmented reality, and more generally 3D reconstruction applications are gaining a lot of traction in the sports entertainment world. In the scientific area, most 3D reconstruction algorithms rely heavily on generic keypoint detection and only a few use more complex, yet very generic, geometric objects such as lines and circles. These simple geometric objects are very common components in images of sport fields. The goal of the internship will be to develop generic detectors that can localize pitches geometric elements, whatever the sport.

Inspired by the latest advances in point and line detection and leveraging the standardization of sports fields, the deep learning models will be trained in a self-supervised fashion. Under the supervision of a computer vision engineer, the intern will be responsible for the creation of a synthetic dataset, the implementation of new detection algorithms in PyTorch, the training and the assessment of the produced models.

The ideal candidate should have knowledge in deep learning and computer vision, and being familiar with Linux, python and PyTorch is considered a plus. They should have prior experience in developing deep learning models and demonstrate an interest in both 3D reconstruction and computer vision. The intern will need to be able to work quite autonomously, while receiving regular guidance and relevant help from members of the Innovation team.



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Automatic tracking using PTZ cameras

Keywords: automatic production, keypoint detection, face detection, people detection, people tracking, camera calibration

In recent years, the demand for small TV productions has increased significantly, driven by the rise of digital platforms and streaming services. These productions often have smaller budgets and limited resources, making it challenging to capture high-quality footage of people in motion. To address these challenges, there is a growing need for automatic tracking systems that can capture high-quality footage of moving subjects in real-time without the need for manual intervention.

This internship project aims to develop such a system using PTZ cameras. The proposed system will be designed to detect the position of people using sensors and automatically adjust the PTZ cameras' position to track their movements. The use of sensors will ensure accurate tracking and eliminate the need for manual adjustments by operators, thereby speeding up the production process.

The main challenge of this internship will be to develop algorithms to calibrate the cameras and transform raw sensor data into PTZ camera commands to ensure smooth and accurate tracking.

Overall, this internship will provide a challenging and exciting opportunity to develop cutting-edge technology for the TV production industry while addressing important research questions in computer vision and robotics. During this internship you will become a part of the innovation team at EVS, and your work will take place under the supervision of a computer vision engineer. You will investigate, implement, and evaluate various strategies.

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Virtual Offside Line Research

Keywords: VAR, VOL, calibration, player detection, pose estimation, tracking

Xeebra is the virtual assistant referee tool developed by EVS. This product includes a Virtual Offside Line functionality that is essential for soccer games nowadays. In order to ease the drawing of the offside line in augmented reality, this VOL feature contains sophisticated deep learning and computer vision algorithms. With the current state of the art in human and limb tracking, it is now possible to almost automate the offside line positioning completely.

Depending on the current needs of the team and mostly on interests of the intern, the goal of this internship is to work on improvements of some specific sub-parts of the VOL component. It could be an investigation about camera calibration, soccer pitch detection, player limb detection and tracking, player 3D skeleton reconstruction, human mesh generation, ...

There are many ways to conduct research around refereeing in soccer, but in any case, the intern will be guided by one or two computer vision engineers, and the intern will get the chance to perform scientific research that will benefit to a real-world product. The internship will consist in reviewing the state-of-the-art methods relevant to the chosen problem, setting up an experimental environment to implement and test the computer vision/deep learning algorithms, and finally a quantification of the benefits of the research conducted by the intern for the product.

The ideal candidate for this internship has a good background in deep learning and computer vision, especially on camera calibration, and some experience with python, PyTorch, and Linux.

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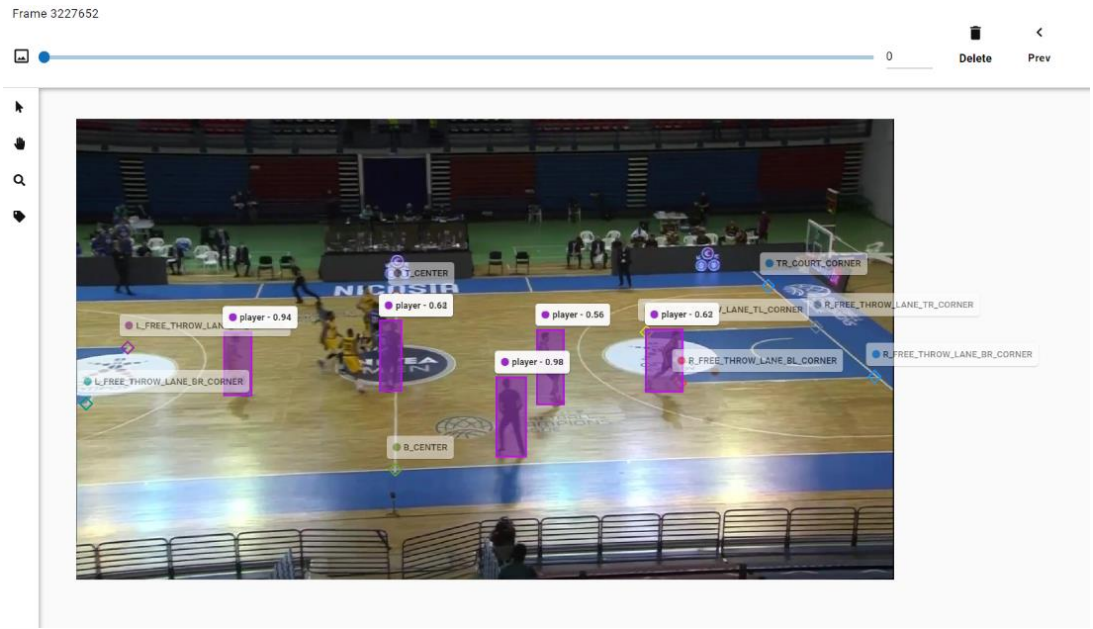
From Functional to Smart Annotation Tools

Keywords: automated annotation, MLOps, react, database, big data

Training Deep Neural Networks requires huge amount of annotated data. EVS Innovation Engineers are using a large database to store several millions of image annotations. Every day, sequences of images are collected, stored and require manual annotation.

As constructing datasets is a lengthy process, automating as much as possible the work of the annotator is essential. A first goal of this internship is to leverage existing deep neural networks trained by EVS team to perform player and ball detection in order to ease the collection of bigger datasets that will be used for detection and tracking. More generally, the goal of the internship is to extend the EVS' annotation tool with handcrafted features to enable automatic annotation, to assist our annotators and to drastically increase the quality, as well as the quantity, of annotations.

The ideal candidate for this internship is keen to take on MLOps subjects, has knowledge about both JavaScript, web development and deep learning. The candidate will benefit from the guidance and expertise of both computer vision engineers, MLOps engineers, and the experience and feedback of our annotators.



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