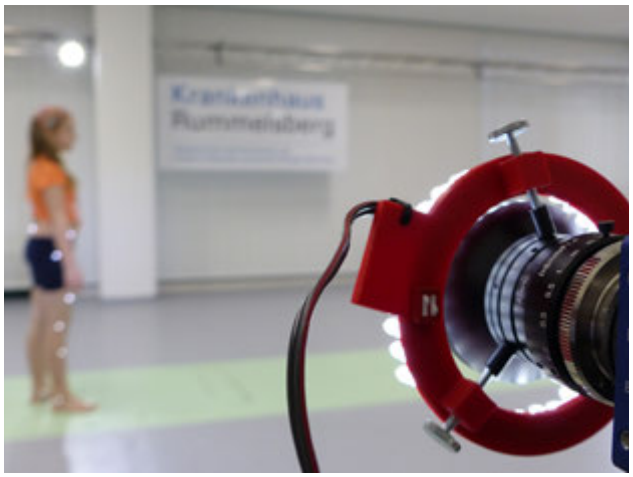
A gait laboratory was established - the first of its kind worldwide to use its image-based system. This technology allows experts to diagnose gait disorders more quickly and easily and to plan better treatment.

Walk Well

The system was designed by the company Simi Reality Motion Systems GmbH, based in Unterschleißheim, which has more than 20 years' experience with systems for movement and behaviour analysis and occupies a leading position in this field. The video footage for analysis is captured by high-speed cameras manufactured by MATRIX VISION in Oppenweiler.



Innovative diagnostics enables more individualized therapies

The laboratory is impressive. As soon as you step foot in the room, you notice the bright halogen spotlights in every corner, illuminating a marked walkway. Patients pace up and down the 15 m-long track with special markers attached to various points on their bodies. At the same time, a screen allows you to watch as curves and graphs take shape in a diagram: the patients' body axes are simulated in real time in a three-dimensional reconstruction. In addition, eight high-speed cameras record the patients from the side, in front and behind. The footage is shown on the screen. It is then used at a later treatment stage to provide assistance in accurately tailoring the treatment to the patients - whether during the planning stage in the outpatient department, directly in the operating theatre during a potential operation or when producing custom-fit aids in the hospital's internal orthopaedic workshop.

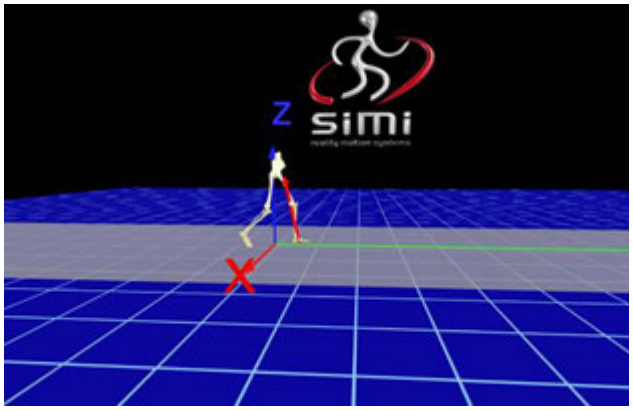
Advantages of the Image-Based System

The image-based system lends the new gait lab a special advantage in comparison with traditional infrared-based systems. Infrared-based technologies only measure the coordinates of the markers and reconstruct a schematic 3D model using the data they obtain. To achieve a good result, you need a high number of markers. For many patients, especially children or patients with Parkinson's, the lengthy process of attaching the markers can be very straining.

The image-based process, on the other hand, also shows the gait pattern of the patient in real time, as it uses high-speed cameras as well as artificial 3D reconstruction. In addition to using individual (and far fewer) markers in comparison with infrared-based systems, the image-based process also makes it possible to perform a markerless gait analysis using a method known as silhouette tracking. This means that there is no longer a need to attach markers, making the gait analysis procedure altogether quicker and easier to carry out. While the human eye is limited to around 20 images per second, the high-speed cameras capture many times that number. This allows experienced orthopaedists to identify causes and effects of a gait disorder even if clinical investigations do not allow them to draw sufficient conclusions. Although the amount of data collected by the HD cameras is enormous, it is possible to save this data and use it in a day-to-day clinical setting, as storage options have now become quicker and less expensive.

Consideration when Selecting a Camera

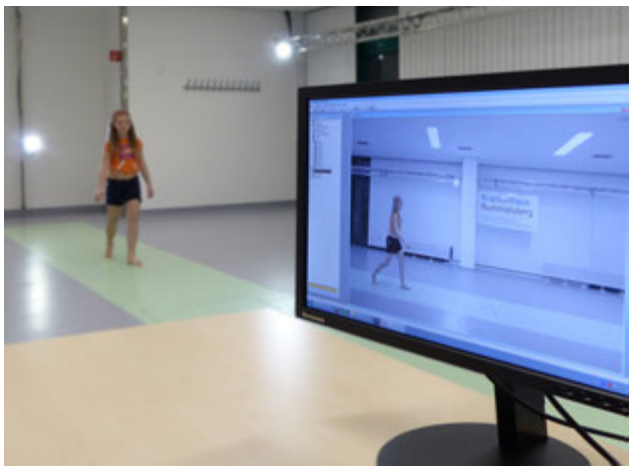
Simi already had concrete ideas for the camera during the development stage. They decided that the camera needed to be as robust as it was handy with resolution of at least 1920 x 1080 pixels and full HD capability. As the planned length of the walkway was at least 15 m, distances of at least 7.5 m between the analysis PC and the cameras would need to be overcome, if the analysis PC were to be placed in the centre. Given that, when using USB 3.0-based solutions, interference-free transfer can only be guaranteed if using cables of less than 4



The work screen shows the individual walking picture

m long, Simi took the decision to deploy a network-based solution. However, it was noted that, when using eight Gigabit Ethernet HD cameras, the net bandwidth of approximately 120 MB/s available for Gigabit Ethernet would soon be exceeded: 8 x 1920 x 1080 x 30 (images per second) x 8 (bit image data) = approx. 500 MB/s. Simi considered that this problem could be solved by bundling the Gigabit Ethernet cabling with sufficient image storage buffer in one camera and found the right solution in the mvBlueCOUGAR-XD range from MATRIX VISION. The XD range consists of Dual-GigE cameras which can bundle two Gigabit Ethernet cables into one via link aggregation and therefore provide net bandwidth of approximately 340 MB/s. In addition, the cameras offer image memory of 256 MB which, when configured correctly, compensates for the lacking bandwidth.

There was then only the right model left to find. As, on the one hand, CCD sensors are too expensive, and, on the other, they are set to be phased out of production by 2025 at the latest, a CMOS sensor was needed. Additionally, a global shutter was of course required due to the movement in the image. The MATRIX VISION portfolio presented us with the solution: the mvBlueCOUGAR-XD104dC, which uses the Pregius Sensor IMX174, manufactured by Sony. With a resolution of 1936 x 1216 pixels, this supports full HD, has a maximum refresh rate of 105 Hz and is a global shutter sensor.



Images: Matrix Vision GmbH

Various measurement- and picture-data support the analysis

Simple Integration and Excellent Image Quality

Simi was impressed by the Sony sensor. It sets new standards in the fields of dynamics, speed, quantum efficiency and noise, and showed excellent results. Integrating the camera and establishing the network were completed quickly, confirming Simi's decision to use the MATRIX VISION camera. And it doesn't stop there: the doctors on site are also impressed with the new lab. Using movement analysis, treatments can be further refined and matched more accurately to the patients. For example, a monitor in the operating theatre allows the doctors to see the gait pattern once more before performing surgery. The orthopaedic workshop can make its aids more individualised to more accurately meet the needs of the patients and the gait pattern can even be transferred into the outpatient department. What's more, it is also possible to assess the success of a treatment more independently afterwards and monitor that success in the long term. Better than what would be possible with the human eye.

Conclusion

Whether it's dental cameras, endoscopes or cameras to be used in ophthalmology or dermatology, industrial cameras are now an integral part of many areas of medicine. They make it possible to carry out remote diagnoses and robot-assisted surgeries, they document diagnoses and make things visible that would otherwise have remained hidden. Many doctors are grateful for the new opportunities offered by a digital eye. Yet this image-based system does not just come in useful in orthopaedics; in sport, movement analysis also has the potential to extract those decisive milliseconds by optimising your movements. In a year that has seen the Rio Olympics and the many recent doping scandals, it is nice to know that there are also normal ways and means of improving times, distances and heights in sport. It's just a case of actually putting this technology to use.

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