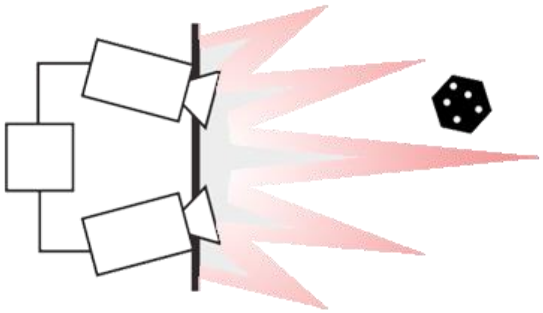
PS-Tech tracking technology used for Augmented and Virtual Reality

PS-Tech

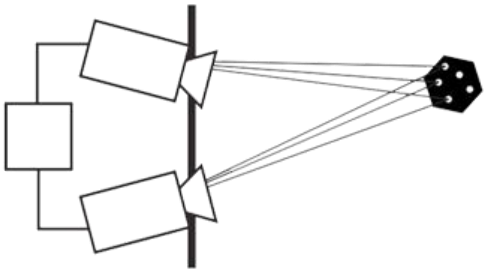
PS-Tech was founded in 2005 as Personal Space Technologies B.V. and is a spin-off company of the Center for Mathematics and Computer Science (www.cwi.nl). The company is based in Amsterdam, the Netherlands. PS-Tech specializes in Optical Motion Tracking and professional 3D Visualization solutions. Our systems are found in hospitals, industrial design environments, research institutes, museums and universities. Business areas range from industrial design, training and simulation, serious gaming to the car industry.

PS-Tech optical tracking technology

The Personal Space Tracker (PST) is a near-field optical tracking system developed by PS-tech. The PST can be used to determine the 3D position and orientation (or pose) of arbitrary objects. The PST illuminates the environment with infrared light. Objects are equipped with retro-reflective markers that reflect incoming light back to the cameras. The properties of these markers in the camera images can be obtained efficiently. By using multiple cameras, the system can determine the 3D position of each marker.



The object is lit using near IR light



Retro-reflective markers reflect back

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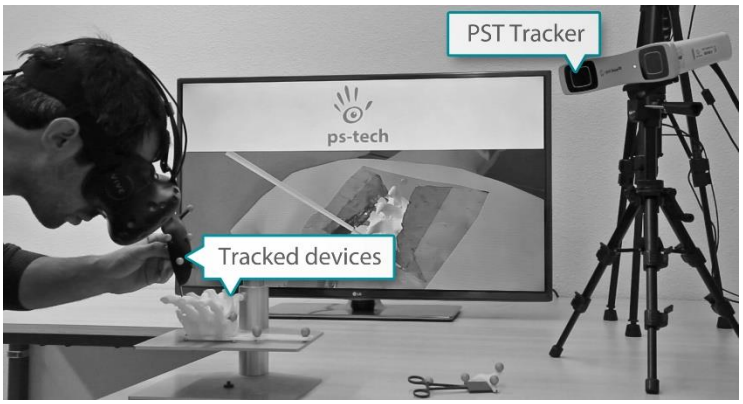
Context

PS-Tech trackers are used more and more for VR use cases, combining HMDs technologies and PST optical tracking solution. For instance, welding training, medical training and surgical procedure planning. The key advantage is to be able to track tangible tools and instruments shown in the Virtual world to validate and learn the real gesture, get accurate feedback on the object position, and also actual force feedback when the real tools are touching other objects.



Internship possibilities

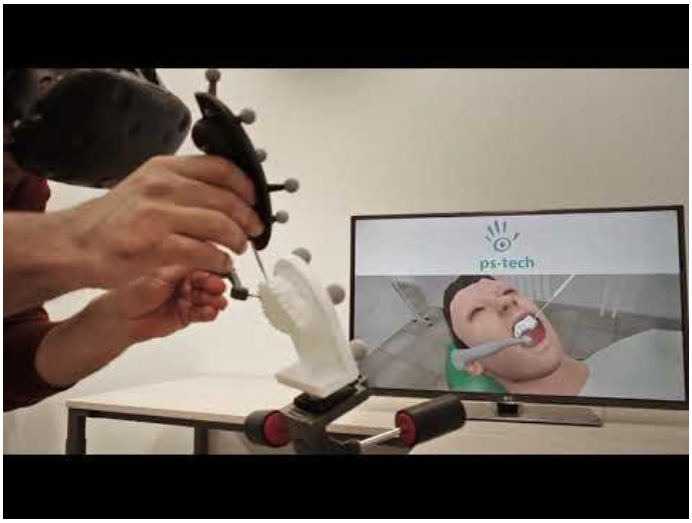
The following internships aims at improving the integrability and the robustness of the tracking result for VR experience with HMDs.

Projects will focus on:

- **Alignment**
  Currently, the alignment of the real and the virtual models has to be done by the end user.

- **Combining tracking technologies**
  Different tracking technologies are to be combined, which requires aligned coordinate systems, synchronized tracking results and error measurement (confidence measure).

- **Occlusion**
  During the VR experience, it is critical to limit the risk of occlusion, and optimize the accuracy for specific locations.



Video from http://www.ps-tech.com/optical-trackers/custom-solutions-for-optical-trackers

Subject 1: Developing an algorithm to compute the optimal infra-red markers location on a target

The End user can track any custom object on which he has placed IR markers randomly. Nevertheless, the orientation, the distance and the amount of markers has an impact on the tracking result in terms of accuracy and robustness against occlusion.
The aim of this internship is to develop an algorithm that allows the end user to optimize the placement of IR markers on his model. The challenge is to increase the accuracy and predict/lower the risk of occlusion.

Typically, this algorithm takes a 3D model as an input. Eventually it also takes occluded/restricted areas on the object and a set of desired 3D positions where the tracking result has to be optimal. The output will be a list of marker locations and sizes for an optimal coverage of the object.

Subject 2: Optimizing tracking algorithm and calibration procedure for predefined model or 3D location

PS-Tech's current tracking technology allows the end user to track any object by randomly covering it with IR markers and registering it in the application during a training procedure. In some cases, the end user integrates PS-Tech technology into its own solution, using standardized models and/or know location of the target.
The goal of this internship is to use this information to optimize the tracking algorithm in terms of accuracy, robustness against occlusion and efficiency.
In subject 1, the intent is to improve the coverage of a random object with IR markers, while here, the idea is to improve the tracking algorithm using specific known models.

Subject 3: Combining tracking technologies:
Developing an algorithm for fast alignment and error correction based on a 3D map of the relative error

When using 2 different tracking technologies, for instance the HTC lighthouse system and PST trackers, it is necessary to report positions in the same coordinate system. Also, it is important to ensure consistency between the 2 reported measurements all over the 3D space considering that each system has its own extrinsic and intrinsic error, which might be unknown beforehand.

The first part of the internship is about developing a very easy and fast alignment procedure for the end user. For that procedure, it has to be taken into account that the inputs (as minimal as possible) from the 2 systems may be completely uncorrelated (i.e. not time synchronized or not even matching the same 3D position).

The second part of the internship consist of developing an algorithm to determine and correct the relative error between 2 systems, based on a finite number of point taken over the 3D space. These positions might eventually be known or (ideally) being completely random.

Your competencies

- Programming skills, preferably C++.
- Windows operating system.
- Interest in image analysis and computer vision.
- Minimal knowledge in Mathematics (probability and geometry).
- Good communication skills.

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