Miguel Sainz's participation in Projects

Revicat: The Remote Virtual Catwalk

Description: The proposed industry-partnered project consists of developing a client-server system to visualize and simulate in 3D space garment worn by a virtual character constructed from images of a real person.

Duration: 10/2003 - 10/2004.

Personal Role: Designing and directing the development of the character reconstruction form images. GPU algorithm development for cloth animation on an articulated character.

Details: The simulator allows to change the physical properties of the cloth, thus changing the dynamic behavior of the garments in real-time using the GPU when available. The different garments can be created using standard 2D garment patterns and then attached in 3D space to the virtual character. The 3D visualization process is designed to be feasible for a wide range of local or remote clients with none to full 3D hardware acceleration capabilities and broadband internet connection.

SPOC: Simple Point-based Object Capturing

Description: The goal of this work was to develop a complete automatic pipeline to capture, process and render point-based models from images of real objects.

Duration: 09/2003 - 11/2003.

Personal role: Developing the complete image based modeling pipeline from image acquisition and calibration to reconstruction and point color estimation. Also developing the hardware accelerated rendering pipeline.

Details: The input to our system is an uncalibrated video-sequence showing different perspectives of the object to model. The proposed solution starts with a calibration of the input sequence based on feature detection and a divide and conquer linear calibration technique. The calibration information is then used to obtain a cloud of points of the surface of the object using a method inspired by the visual hull and voxel carving techniques. Then a post-process of the points is performed to smooth the reconstructed points positions and normal orientations. Finally a hardware accelerated multi-resolution point-based rendering pipeline is used to obtain high quality images of the reconstructed objects at interactive frame rates.

Confetti: a Point Based Rendering System

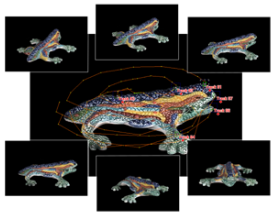
Description: In this project we developed a novel point-based rendering approach based on object-space point interpolation of densely sampled surfaces.

Duration: 11/2002 - 5/2003 (phase 1) and 11/2003 - 04/2004 (phase 2)

Personal Role: in phase 1 developing the real-time GPU based rendering pipeline. In phase 2, designing and implementing new LOD paradigms as well as improving the rendering engine performance.

Details: We introduced the concept of a transformation-invariant covariance matrix of a set of points which can efficiently be used to determine splat sizes in a multiresolution point hierarchy. We also analyzed continuous point interpolation in object-space, and we defined a new class of parametrized blending kernels as well as a normalization procedure to achieve smooth blending. Furthermore, we proposed a GPU accelerated rendering algorithm based on texture mapping and blending as well as programmable vertex- and pixel-shaders to achieve interactive framerates.

3D Modeling From Images and Video Streams



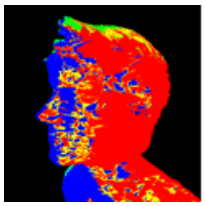
Description: The goal of the proposed research project is to develop a software tool, based on image based modeling techniques from video sequences, which will allow the automatic construction of real world objects.

Duration: 09/1999 - 06/2003.

Personal Role: This project is the main research of my doctoral degree. I designed and developed the complete acquisition, modeling and rendering pipelines.

Details: Besides new techniques for image camera calibration I also defined new ways of shape representation that are both adequate for the reconstruction process and can achieve high photorealism, such as point based models or image based models. I also developed new approaches for real-time rendering algorithms of the reconstructed models, exploiting the hardware acceleration on today's videocards.

Depth-Image Meshing and Warping



Description: In this project we developed a novel and efficient depth-image representation and warping technique based on a piece-wise linear approximation of the depth-image as a textured and simplified triangle mesh.

Duration: 09/2002 - 06/2003.

Personal Role: Developing the rendering engine for the image based objects using GPU acceleration and programmability. Participation on the design of applications using the DMesh technology.

Details: We describe the application of a hierarchical triangulation method to generate view-dependent triangulated depth-meshes efficiently from reference depth-images, and propose a new hardware accelerated depth-image rendering technique that supports per-pixel weighted blending of multiple depth-images in real-time. Applications of our technique include image-based object representations and the use of depth-images in large scale walk-through visualization systems.

JERICHO: Browsers Embedded in 3D Multi-user Environments

Description: The objective of the Jericho project was to provide users the full functionality or their personal computers from within a multi-user 3D environment like those found in computer games.

Duration: 01/2001 - 09/2001.

Personal Role: Developing new extensions to the game engine to support high quality texture mapping and more articulated characters. Directing the character animation team to generate new character types for the engine.

Details: The prototype developed demonstrates the *Displays* window graphical user interface, embedded in a 3D game. The prototype provides Web browser, graphics, game, accessory and other applications that work simultaneously with on going game action. We highly modified and improved the graphical and networking modules of ID Software's Quake^{tm} game engine to integrate our GUI functionality within the 3D virtual environment of the game. Currently the system has been copyrighted by the researchers of University of California, Irvine.

Dark Frost: A computer game engine

Description: This team project was a test-bed for developing a complete 3D first person perspective game engine including network modules and protocols for multiplayer capabilities.

Duration: 04/2000 - 06/2000.

Personal Role: Lead programmer of the graphical engine, collision detection, character animation and level design. Participation in network protocol design.

Details: The 3D engine was based in portal culling and was optimally implemented in OpenGL to obtain high frame rates. A collision detection module was built to allow interaction of multiple players with the environment and a complete networking protocol was built to minimize the bandwidth maximizing playability. Character modeling and animation was also included to provide avatars for the players. The final complete was a success and allowed to learn and improve some of the actual techniques used in real 3D games.

VR Harbor crane simulator

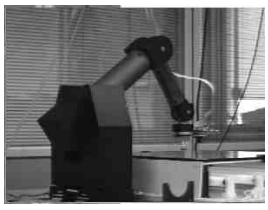
Description: This project consisted on developing computer graphics special effects to improve the visual quality on a VR harbor crane simulator constructed by our industrial partner.

Duration: 03/1998 - 09/1998

Personal Role: Designing the optimized solutions and developing the API's for the industrial partner for effects such as: rain, bulk material (sand and grain piles), physically realistic non-rigid cables and animated characters.

Details: The system was developed using Silicon Graphics platforms and the Performer real time animation libraries. Several modules where designed and implemented to simulate realistically (1) non-rigid cables such as the ones on the cranes, (2) bulk material loaded and unloaded from the ships, (3) animated characters ("bots") working on the docks and atmospheric effects such as rain. The main constraints were implementation time and computation cost, since the simulator was already running a physics engine and other complex subsystems such as a haptic platform.

Robot teleprogramming



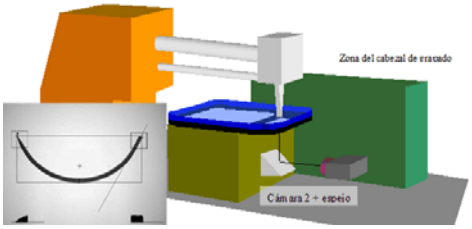
Description: This project was a robot teleprogramming application that allowed users to program, simulate and remotely guide a robotic arm via TCP/IP.

Duration: during 02/1998

Personal Role: Developing the TCP/IP communication protocol for clients to remotely connect to the robot server and developing the client visual feedback system.

Details: During the yearly forum of La Salle, School of Engineering several industry partners are invited, and both the university and industry present to the students their main activities of research and production. 1998's subject was the *high speed communications networks*, and the multimedia center, CITeM, showed a robot teleprogramming application. We developed the complete application consisting in the following modules: (1) A robot simulator which allowed the operator to specify complex tasks off-line and send them to the robot. (2) A visual feedback system based in a CODEC (coder/decoder) to send live images over the internet and (3) an observation system allowing a distributed network of clients to receive visual and/or simulated feedback on the task.

Surgical needles threading machine



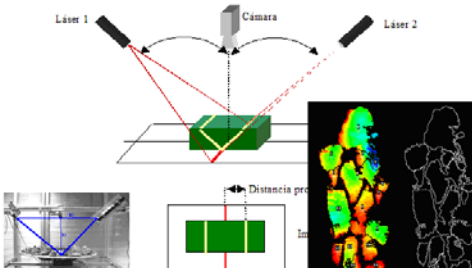
Description: The objective of this industry funded project was the design an implementation of a prototype of an automatic threading machine for surgical needles for a medical equipment manufacturer.

Duration: 04/1997 - 06/1997 (phase 1) and 09/1997 - 01/1998 (phase 2)

Personal Role: during phase 1 (a feasibility study), developing the basic computer vision application to perform the detection and recognition of surgical needles, and developing the communication protocol with the robotic system. During phase 2 implementing the complete API for detection of surgical needles as well as determining position and orientation for commanding the robot.

Details: The group at the IRI was hired to develop a computer vision algorithm to feed the threading machine using a robotic arm. The main requirements were processing time and proper manipulation of the needles. An initial feasibility study of different solutions for the threadable needle end recognition problem, and the needle transport from scene to threading dock problem. The second phase was the complete implementation of the final vision algorithms in the real machine. Two cameras were used in conjunction with a back illumination system. Several blob measuring and statistical analysis techniques were been used to locate the needles in the scene and to recognize the threadable end.

Rock size measurement



Description: The objective of this project was to design and evaluate the feasibility of a prototype to estimate rock size distribution of copper mineral from a conveyor belt feeding up the grinding mills. This project was a European Project initiative partnered with one of top world copper producers.

Duration: 01/1997 - 03/1997

Personal Role: Designing the acquisition system with linear lasers and a CCD camera. Developing the acquisition algorithms and the high level processing for rock size estimation.

Details: In mining industry, the process of mineral extraction requires a very expensive energy-wise grinding process that is severely affected by the rock size distribution in the conveyor belts feeding the mills. The system was based in computer vision and neural networks recognition techniques of range images obtained using a in-house dual laser system.