4D Modelling: From Video to Interactive 3D Digital Media Content

Adrian Hilton
Centre for Vision, Speech & Signal Processing
University of Surrey, UK
courtesy Chico Lima VFX supervisor
content = real + computer generated

= sampled data + 3D models

2D video

common representation

4D = 3D + time

Challenge: 4D Representation of Real Scenes
Film Production Pipeline for 3D Scene Creation
3D Static Capture

Structure-from-motion

KinectFusion [Newcombe ISMAR'11]

LiDAR
3D Video Capture

Multi-view video reconstruction [Guillemaut IJCV’11]

Video+depth [kinect, tof]

Kinect input

Kinect input
Challenges in 3D capture

Environment
Current: controlled illumination & background

Required:
- large capture volume
- moving cameras
- moving background
- multiple actors
- loose clothing/hair
- general surface reflectance
Challenges in 3D Capture

Data

Current: huge multi-modal unstructured data sets

Required:

- structured data/models
- surface reflectance
- common representation
- integration with CG tools
- interactive control
Novel representation for digital media beyond sample-based (video) & model-based (graphics)

**Combine video & CGI**
- manipulation of video with flexibility of CG
- CG with the realism of video

**SCENE**
- format: common video & CG production
- camera: video+depth
- tools: data to structured scene format
Challenge: capture, representation & manipulation of natural scenes
4D = 3D + time

4D enables interactive control of CG

3D video:
- unstructured mesh sequence
- no temporal correspondence

4D model:
- structured mesh sequence
- temporal correspondence
3D video database

4D Model

SurfCap [Starck et al. CGA’07]
Global Alignment [Budd et al. IJCV’12]
4D Animation

Challenge: Interactive control of CG character animation

- editing motion
- high-level parameterisation of motion
- transitions between motions
Immersive Production & Delivery of Interactive 3D Content

Production of animated content from 3D video

- Realism of video
- Interactivity of CG

RE@CT

capture: 3D video + mocap
characters: 4D model
animation: parametric motion graph

www.react-project.eu
4D motion editing

Space-Time Editing
Gate specified by foot placement

Original
Edited

[Tejera et al. CVMP 2011]
4D motion parameterisation

Real-Time Motion Parameterisation

[Casas et al. ACM i3D 2012]
4D Interactive Control

Real-Time Interactive Motion Parameterisation

Speed Control

[Casas et al. IEEE TVCG 2012]
4D Modelling

Performance capture
- 3D video capture
- indoor/outdoor

Representation
- structured
- temporally aligned

Interactive Animation
- control of CG
- motion editing
- real-time high-level control
Future Content Production

**Convergence of sample-based & model-based media**
- Realism of video in natural scenes
- Artistic control of CG (editing, lighting, etc.)

**Production of animated content from 3D video**
- Realism of video performance capture
- Interactivity of CG (motion, real-time control)

CG with the realism of video
or video with the interactivity of CG
Future Content Production: Challenges

3D Capture
- Natural scenes
- Reflectance
- Data volume

4D Modelling
- Temporal alignment
- General surfaces
- Photo-realism

CG Pipeline
- Formats & tools integrating real and CG
- Networked media interaction
- Social media creation & interaction
4D Vision:
From Video to Interactive 3D Digital Media Content
Adrian Hilton
surrey.ac.uk/cvssp

4D Vision:
From Video to Interactive 3D Digital Media Content
Adrian Hilton
surrey.ac.uk/cvssp

CVSSP Researchers:
Jon Starck, Jean-Yves Guillemaut, Peng Huang, Joe Kilner, Hansung Kim, Takeshi Takai, Evren Imre, Chris Budd, Dan Casas, Margara Tejera, Martin Klaudiny, Sarim Muhammad, Peter Stroia-Williams, Mykyta Fastovets, Alexandros Neophytou, Edd Brookes, Marco Volino, Charles Malleson