The rig used for “Bullet Time” in *The Matrix*

**CNM 190**
**Advanced Digital Animation**
*Lec 06 : Cinematography & Editing Techniques*

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Overview

What you know already
- Basic cinematography
- Distance of shot
  - Extreme close up
  - Close up (CU)
  - Medium close up (MCU)
  - Medium shot (MS)
  - Long shot
  - Point of view (POV) shot
  - Birds eye view shot
- Camera Angles
  - Low angle (fear)
  - High angle (weakness)
  - Straight Angle

What you’ll learn today
- Classic techniques of cinematography & editing
  - Why study classical techniques?
  - Film & Editing Resources
  - Review
  - Continuity Editing
  - Duration
  - Camera Direction
- Procedural techniques of cinematography & editing
  - Motion Interpolation
  - Quaternions & Slerping
  - Splines
Why Study Classic Techniques?

Those who cannot remember the past are condemned to repeat it. - Santayana

- You don’t want your camera and editing to obstruct your storytelling
- Instead, use them as tools to advance narrative!
- If you want to break the rules, you need to know what they are first!
  - Do it for a good, artistic reason, not ignorance!
Film & Editing Resources

Film Art : An Introduction
- by David Bordwell & Kristin Thompson
- $38 on Amazon

In the Blink of an Eye (2nd Edition)
- Walter Murch
- Silman-James Press, 2001
- $11 on Amazon
Six Main Criteria of Film Editing

- Walter Murch
  - Four Academy nominations for films edited on different systems
  - Film editing Pioneer!
- He ranks 6 editing criteria
  1. Emotion
  2. Story
  3. Rhythm
  4. Eye trace
  5. 2D place of the screen
  6. 3D space of action
**Continuity Editing (CE)**

[en.wikipedia.org/wiki/Continuity_editing](http://en.wikipedia.org/wiki/Continuity_editing)

- **Goal**
  - Make the editor as invisible as possible
  - The viewer should not notice the cuts
  - Shots should flow together naturally (direction, position, time)
  - Sequence of shots should appear to be continuous in time and space to advance narrative

- If you notice (editor, temperature in a room), something is wrong.

![Steenbeck film editing machine rollers](neighbors1920.jpg)

Neighbors, 1920
CE : (Re)Establishing Shot

- As the name implies, it “establishes” the scene and/or its participants
- E.g., Seinfeld’s restaurant exterior shot before an interior scene
- What is your establishing shot?

Exterior of “Monk’s” restaurant from Seinfeld
CE : 180 degree rule

- Often called The Line or Line of Action, it allows the camera to stay in the green area.
- If the camera violates this (crossing the line into the red), the characters will swap places on screen!
- Subjects should be spatially consistent, with consistent axis of action.
- You can cross the line with intermediate head-on shot, POV or reestablishing shot, but try to avoid this if possible.

The green camera preserves Left/Right positions.

Saturday Night Fever
CE : Shot/Reverse Shot & Eyeline Matches

- A shot from the opposite side of the green 180° area
  - Often used as establishing
  - 30° rule: Camera moves at least that much between shots

- An **eyeline match** is one that associates what a character is looking at
  - You see what they saw
  - It often associates matching close-ups

- In film, characters don’t even have to be in same room!

Scenes from *Peking Opera Blues*, 1986

Scenes from *The Stendhal Syndrome*, 1996
CE : Graphic Match

- Two successive shots joined so as to suggest a similarity
  - Color
  - Shape
  - Location
- Some feel they are “heavy-handed”, not subtle
- Kubrick’s classic 2001 A Space Odyssey: bone → spaceship

Scenes from Women on the Verge of a Nervous Breakdown, 1988

Finding Nemo Main Titles
CE: Match/Cut on Action (MOA)

- Cuts between shots are more seamless if they occur on action
- Definition: A cut which splices two different views of the same action together at the same moment in the movement
- E.g., if A is getting up and walks to the window, cut as he’s getting up, not before.
  - Cutting after could be eyeline match
- MOA can help with a jumpy cut
- MOA can be a subtle motion too

Scenes from Traffic, 2000
**CE : Cut-in, Cut away**

- **Cut-in**
  - Instantaneous cut to a close-up of something already in frame

- **Cut away**
  - Close-up to something in scene but not in the frame (usually)

- E.g., if you had a character getting up to answer the door, you might cut away to a knock.

Scenes from *Dancer in the Dark*, 2000
CE : Cross-cutting

A series of cutaways & cutbacks
Also known as Parallel Editing or Parallel Montage
  - Alternating shots of “two or more lines of action occurring in different places, usually simultaneously”
  - E.g., a chase scene. First the cops, then the robbers, then the cops...
  - Can also be used symbolically
    - Show a 1930s man in line for bread, then a rich man getting into a Rolls
  - In film, this can be used to cheat
    - A man running from a train doesn’t have to be anywhere near it!

The Simpsons used to do this a lot until Family Guy started too, then they quit!

Scenes from Yi Yi, 2000
The father and daughter are both on first dates (different countries)
CE Rule #1: Avoid Jump/Elliptical Cuts!

A shot transition that omits parts of an event, as if had ellipses (...) in plot
  - Also a cut with too-similar framing
  - Or with straight angle but different people (they look like they morph!)

It’s what you would do if you had no training in editing and just cut pieces of a story together
  - It usually looks like a mistake!
  - This is what iTunes does when it summarizes a game into 10 min!
  - In the sixties, there was a wave of it

To avoid
  - Zoom instead of cut
  - Make the framing more different
  - Use the match techniques

A jump cut from wide shot to semi-wide
A better cut (wide / mid / medium close-up)

Dancer in the Dark
CE Suggestions

www.filmclass.com/flm222/continuity.pdf

- Avoid home video style
  - Move subjects away from center of the frame; don’t shoot frontally
    - Thus avoiding “character morph” jump cuts
    - This is a good idea in general, even from a photographer’s standpoint
  - Have a smooth camera!!
  - Use a variety of shots and CE!
  - Watch: “Quick Tips: Using the rule of thirds” on YouTube

- “The single most common mistake in beginning student productions is that they have no, or not enough close-ups”

Headshots from The Apprentice, 2004
Alternatives to CE

Elliptical editing (jump-cuts)

Montage

- Montage: French for “editing”
- In this context, we mean disparate images/shots that tell a story
- Developed by 1920s Soviet theorists, e.g., Sergei Eisenstein
- Five varieties of montage:
  - Metric (# of frames)
  - Rhythmic (rhythm)
  - Tonal (light-dark contrasts), overtone (emotions)
  - Intellectual (all 4 but for meaning)


Godfather (1973) Montage, Michael showing his duty to his two “families”

Traffic, Godfather
Thanks to editing, time is completely in your control. You can...

- have a very long take
- cut boring events out (compress time)
- Extend one event to the whole film! (24)
- revisit it over and over
- change the rhythm
- explore the space-time continuum!
Long Take (Plan-sequence)

- A shot of unusual length
  - Draws attention to itself, very different from norm
  - Shots above 1 minute are now considered a long take
  - Extremely hard to shoot in real life, but trivial in CG
  - Depending on movement, can make film intense, carefree, or stagnant!

- Examples
  - Orson Welles’ Touch of Evil
  - Robert Altman’s The Player
  - David Fincher’s Panic Room
    - Lots of CG tricks!

The Player (1992) 8-minute shot!

Touch of Evil, The Player, Goodfellas
Overlapping Editing

Cuts that recall part of the action, as if instant replay

- Draws attention to itself, again very distinctive
- Usually associated with experimental filmmaking
- Usually found in films where action >> plot
- Common in Hong Kong action films of the 80s / 90s

Rhythm is the “perceived” rate of sounds, movements & series of shots

- Usually it’s the cuts that determines the rhythm
- Just as the story has rhythm, so does the editing
- #3 of Murch’s six main criteria when it comes to film editing
- There’s a feeling that this fine art has been lost as we cater to the ADD MTV generation

The Good, the Bad and the Ugly (1966)
Imagine time and space as a two-dimensional graph:

- We can traverse anywhere in this space! (easy in CG)

The rig used for Bullet time in *The Matrix*

Making of *The Matrix*
Camera Direction

Inspired 3D Short Film Production

- **Lock-off camera**
  - Simplest form of setup
  - Position, angle, zoom, focus fixed throughout the shot
  - A film consisting only of lock-off shots will feel dull

- **Camera move**
  - Rotating, moving, zooming, shifting focus or field of view
  - A film where the camera never stops moving can be unsettling.
    - When does this ride end?

- “Try not to get too carried away with camera moves”

- Mantra: smooth cameras
Rack Focus

- Changing the focus of a lens so that one element goes out and another comes into focus
- By default, CG images are through a pinhole camera
  - Infinite depth of field!
- Done in Maya via a choice of Depth of Field in Camera and adjusting the Focus Distance
  - Render times explode!
  - Can be cheated in post by blurring composite layers

Peking Opera Blues (1986) Racking Focus
Maya Turntable Demo

- Creating a turntable, or “how to rotate a camera around the center of the world”
  - Select camera group
  - Set keyframes to the start and end with 0 degrees and 360 degrees Y rotation
Linear vs Ease-in, Ease-out

- Linear interpolation of motion produces very unreal motion (Lerping)
  - \[ P(t) = (1-t) P_0 + t P_1 \]
  - Nothing has infinite acceleration!

- Ease-in, Ease-out
  - \[ P(t) = (1-f(t)) P_0 + f(t) P_1 \]
  - With \( f(t) \) being something smooth like the blue curve on the right

- \[ f(t) = (\sin(\pi t - \pi/2) + 1)/2 \]
  - Just one example of \( f(t) \)

www.siggraph.org/education/materials/HyperGraph/animation/rick_parent/Full.html
Orientation Representation & Interpolation

- Fixed Angle Representation
  - Angles about fixed, global axes (e.g., xyz)
  - Gimbal lock when axes align...singularity!
    - Imagine plane straight up; where's yaw?
  - Bad interpolation property

- Euler angles
  - Angles of rotation fixed to object, not global
  - Same problems!
Quaternions

- Technique for encoding 3D orientation
  - Lots of math involved using complex notation
  - Great interpolation properties
  - It finds the great circle arc between two positions
- Interpolating between quaternion poses linearly is called Slerping

en.wikipedia.org/wiki/Quaternions_and.spatial_rotation,Slerp
Smooth motion: Splines (1)

- Piecewise polynomial curves with great properties
- Imagine interpolating lots of points with $y = f(x)$
  - You’d have to have a very high-dimensional function
  - But if you allowed it to be broken up into pieces, you could solve with many lower-dim functions!
- Continuity of pieces?
- Prof Barsky is local expert!

Bezier interpolating spline
Smooth motion: Splines (2)

- Two classes
  - Interpolating (goes through control points)
  - Approximating (gets near the control points)
- Polynomial order?
  - Standard is cubic (order = 3)
- Local control
  - Adjusting control point only affects local part of curve
- Continuity (C0, C1, C2) across joints critically important
- NURBS are generalizations with expressive power
  - Curves AND surfaces

Spline demo gif

en.wikipedia.org/wiki/Nurbs
Conclusion

- If time, look at
  - Youtube: Moviemaking Techniques SHOT TYPES
  - YouTube: Filmmaking Techniques
  - Pixar Shorts

- It’s important to understand the classical techniques of editing & cinematography
  - Use them to facilitate your narrative!
  - Smooth camera motions!!!

- Tremendous power if you code motion yourself…
  - Most SW does heavy lifting!

- Next week:
  - Animation