

The Great Frame Rate Debate

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Film Tradition

- Camera exposed 24 frames each second = 24 fps
 - Fast enough for illusion of motion
- Shutter normally open $\frac{1}{2}$ the time = $\frac{1}{48}$ second
 - Longer shutter = more blur, less stutter
 - Shorter shutter = less blur, more stutter
- Projector shows each frame twice = 48 fps
 - Avoids flicker (only if projection is dim)



US Broadcasting Tradition

- Camera exposed 60 frames each second = 60 fps
 - Couldn't "store" image and display twice, like film does
 - Originally = power line frequency
 - Avoided flicker on early CRTs
 - Noticeable flicker on later bright and sharp CRTs
- No shutter needed = 1/60 second exposure
- Film frames are shown 3 times, 2 times, 3 times...
- "3/2 pull-down"



The New World

- Digital cameras can do anything
 - 24, 30, 60 frames per second, and more
 - Widely varying shutter speeds available
- Distribution channels constrained to 60 fps
- MPEG compression likes repeating frames
- New displays can interpolate frames



Production Decisions

- Why 24 fps?
- Why not?
- Why not 30 fps and avoid pull-down?
- What other frame rates?
- When to use slow shutter speeds?
- When to use fast shutter speeds?

