Techniques & Rationale for Motion Picture Restoration

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Outline

- Factors driving demand for restoration
- Categories of restoration
- Motion picture restoration examples
- Open problems in motion picture image processing
- Restoration examples in detail
Demand for restoration

- Film damage can be distracting
  - Dust and debris
  - Lint and hair
  - Chemical stains & water spots
  - Persistent vertical scratches
  - Cue marks (reel change indicators)
  - Finger prints
  - Film Tears
  - Splice marks
  - Customs stamps!
Demand . . .

- Evolution of tools has raised viewer’s expectations
  - Small community of creative people
  - Intense competition between facilities
  - Pride in finished product
- Post production workflow improvements have made restoration affordable
Workflow model before 1995

- film
  - color correct
  - remove dirt
  - 525 FF
  - 525 LB
  - 625 FF
  - HD
  - airline
  - T.V.
Anecdote

- **Titanic (1997)**
- Huge restoration project in 1998
- 24/7 for 4 weeks. 2 systems.
- Billed 1300 hours
- 12 versions
- 100 hours per version
Modern workflow

- Scan once, use many

Typical new feature film receives about 40 hours of restoration
Demand for restoration

- The DVD revolution
  - Excellent image quality
  - Stop and jog functions
  - Cost structure allows small or niche production runs
  - On VHS, feeble restoration efforts were adequate. Not so for DVD.
Digital projection in theaters

**Star Wars Episode I** (1999) 10 Digital Theaters

**Star Wars Episode III** (2005) 67 Digital Theaters

**My prediction:** digital projection is unstoppable

- Superior image quality
- Reduced distribution costs ($1200 vs. $200)
- Added flexibility for theater

**More demand for restoration**
Image quality

- Standard definition video is 720 columns wide
- High definition video is 1920 columns wide
- Data scans are typically 2048 columns wide
- Special effects are often 4096 columns wide
- Inherent resolution of 35mm film appears to be between 3000 and 4000 columns
Categories of restoration

- New features / Episodic television
  - High volume
  - Adequate budgets available
  - Material not too distressed
    - Chemical stains
    - Isolated dirt
    - Vertical scratches
  - Utter intolerance to artifacts
  - “Crisis of Confidence” is not allowed
Categories . . .

- Major Re-release of marquee titles
  - Few titles per year
  - Large libraries in need of preservation
  - Adequate budgets
  - Material moderately distressed
    - Heavy dirt
    - Splice marks
    - Film tears
  - Intolerance to artifacts
Categories . . .

- Re-release of niche titles
  - High volume
  - Low budgets
  - Severely distressed material
  - Willing to compromise automation for artifacts
Categories . . .

- Archivist preservation of historic titles
  - Careful documentation of preservation decisions
  - Generally funded by government or foundations
  - Not necessarily interested in public distribution
Restoration examples

- Switch to Macintosh demo
Open problems

- Better use of Grammar
  - Cuts are important for dirt removal
  - Automatic splice bump detection & repair at cuts
  - Dissolve might be useful in grain reduction
- Upconvert / super resolution
- Panning too fast for digital cinema
- Image stabilization for digital cinema
Open . . .

- Gate hair
- “This picture came from T.V.”
- “This footage came from a cell phone”
- Motion estimation
Gate Hair

Grain Reduction

Dr. Mabuse (1933)
Repurpose material

- Upconvert SD material to HD. Super resolution.
- Temporal changes
Pans for digital projection

- My prediction: audiences will be confronted with material with objectionable “judder”
- Take a lesson from animation?

The Contender
Motion analysis

- Phase correlation
- Optical flows
- Block matching