History of Color in Cinema

Anthony Stanton
Carnegie Mellon University
Movies in Color

Almost as old as movies themselves

- Kinetiscope projector invented by Edison with Wm. Dickson 1891
- 1890 first motor driven camera had been invented (same team)
- Early films used tinting, toning and hand-coloring

- 1st color film (Dickson & Edison)
  - 1895, *Anabelle’s Dance*, captures Anabelle Moore dancing
  - Embodies the Art Nouveau spirit of movement and color
  - Hints at the mystical connection that cinema would develop with viewers (*The World Viewed*, Cavell)
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- Patented film perforations to guide film through camera/projector
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Le cinématographe Lumière: projection.
Marie-Georges-Jean Méliès

- French illusionist & filmmaker
  - Directed 531 films (1896–1913)
  - Théâtre Robert-Houdin in Paris
  - Special effects, multiple exposures, time-lapse photography, dissolves
  - B&W mostly – some color
  - Many films strange and surreal – began science fiction and horror films
  - 1902 – A Trip to the Moon – frame by frame painting – 21 painters

2011 – Martin Scorsese’s Hugo
  - starts as an adventure film and ends as a historical drama
Women Dominated the Industry

Workforce for hand-coloring was almost entirely women

– They were thought to be more dexterous, more sensitive to color, and they could be paid less

– Prior to the invention of cinema, women dominated the hand-coloring market for lantern slides
Film Tinting in Cinema

• Used for movies as well as still photography

• With tinting, the stock or emulsion is given overall tint – red for firelight or blue for nighttime

• Sonachrome (1929) Kodak pretinted film stocks
  – 17 colors: Peachblow, Inferno, Candle, etc.
Film Toning in Cinema

• Toning replace silver image with mordant dyes giving a hue to the shadows

• Tinting, toning, hand painting sometimes applied together *The Great Train Robbery* (1903)

• Sometimes considered the 1st silent movie – 12 minutes
  – Produced by Thomas Edison
  – Filmed by Edwin Porter
Stencil-Colored Movies

• Stencil coloring displaced hand coloring in early 20th century

• Used etched glass plates to apply dyes to portions of the scene
  – *Pathé Color* – Pathe Freres – 1905 was the first commercial stencil process
  – Pantograph cut areas to make dye masters – high speed dyeing machine – could work on enlarged image (reduced back to film size)
  – Still a frame-by-frame process but the stencils could be reused on subsequent prints
  – No longer used after 1930
Stencil Process

- Usually 3 to 6 colors used for a given frame
- Acid dye transferred onto a black and white image
- Colors were usually pastels
Original release prints of the film were entirely colorized by the Pathechrome stencil color process.
Handschiegl Color Process

• 1916 – three-color lithographic stenciling process
• Engraver Max Handschiegl and cinematographer Alvin Wyckoff
• Used for Joan the Woman Cecil DeMille (1917)
• Was a foundation for the dye-imbibition process used in Technicolor 3
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Handschiegel Dye Transfer Machine

The bleached and dyed negative is brought into contact with the positive on a large sprocket drum for transfer of dye

Lights of Old Broadway (1925, Monta Bell)
Kinemacolor

- George Smith, Brighten Eng.
- 1st films captured in color
  - 1906 – additive color system
  - Commercially used 1908—1914
  - Two color process, 32 fps
- B&W panchromatic film
  - Photographed through alternating red & green filters
  - Positive films made from negs. projected through same filters
- 300 theaters, 54 films
  - Were copycat processes but plagued with color fringing

Images never good enough and projector installations too expensive
Kinemacolor

32 frames per second of each color
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Prizma I Color

William Kelley and Charles Raleigh – 1913

- Started as two-color additive system (like Kinemacolor)
- 1917 – demonstrated a four color process
  - Red, green, yellow, blue
Single Film Projection

William Kelley converted Prizma to subtractive system

- Projecting a bi-pack film sandwich
- 1917 – two films simultaneously exposed in special camera
  - One sensitive to orange-red
  - Other to blue green
  - Each toned with its complementary color
  - Projected with ordinary projector
- Made a stereoscopic version of the camera
Prisma is Sold

- 1922 considered the apex of Prisma color
- Lost suite of Technicolor for patent infringement
- Prizma camera used for 3D film *Power of Love*
- 1923 Samuel Goldwyn produced *Vanity Fair*
- 1928 bought by Consolidated Film Ind.
- Sold patents: Cinecolor
Dufaycolor

• 1908 by Louis Dufay
  – Based on Lumière Autochrome
  – Additive single film process

• 1926 purchased by Spicers
  – Converted to movie film (1931)
  – Fine mosaic RGB laminated to B&W film base
  – Only used for two pictures and several shorts
  – Overtaken by Kodak and Agfa

• Switched to still photography film
  – Lingered until 1956
Dufay film frame showing laminated color mosaic layer
Discolored with time
Dufay film frame restored to original color appearance
Technicolor I

- Technicolor Corp. “tech” from MIT was founded in 1914 by Kalmus, Comstock, & Wescott
- Most widely used color process from 1922 to 1952
- Initially 2-color process -- Goal was “flicker free”
- Suffered from alignment and additive color problems
Technicolor I Capture

- Prism behind single lens splits light through red and green filters onto two frames of filmstrip
Technicolor I Projection

- Projector had two apertures with appropriate filters
- The B&W positive film was projected through filters to reconstruct the original image
Technicolor II

• 1922 Technicolor II, a subtractive process, launched
• Camera was the same
  – Green and red filter frames were printed on separate films.
  – Green filter positive frames were toned orange/red.
  – Red filter positive frames were toned cyan/green
  – Two prints cemented back-to-back to form a projection print
  – Special projector & screen register unnecessary
  – Images were brighter

1922 The Toll of the Sea
1st Technicolor II release
Technicolor II

• Used in:
  – Ten Commandments (1923)
  – Phantom of the Opera (1925)
  – Ben Hur (1925)
  – The Black Pirate (1926)

• Technical problems:
  – Cemented film strips – emulsions not on the same plane
  – Soft focus and cupping from film uneven thickness of film
  – Emulsion on both side doubled the scratching
  – Splicing was difficult leading to film breaks
Technicolor III

- Released in 2028, referred to as Technicolor Process 3
- Based on 1916 dye transfer patent (Max Handschiegl)
- Still two-color
- Dye-imbibition – hardened gelatin submerged in dye bath
- Transferred to blank film stock with gelatin layer coated with mordant
- *Song of the Flame* 1\textsuperscript{st} 65mm Vitascope widescreen

*On With the Show*
1929 – first all-color
All talking movie
Technicolor 4

- 1932 unveiled 3-color process — full spectrum (CMY based)
- Beam splitter divided image into three components
- 1/3 through green filter to panchromatic film
- 2/3 through magenta filter to remove green — then onto pair of films spooled together
- One orthochromatic (not red sensitive) to capture blue then to a panchromatic film to capture remaining red image
Printing Technicolor 4

Becky Sharp 1935
Gone With The Wind
Signin’ In The Rain
Adventures Of Robin Hood
Joan Of Arc
Snow White
Printing Technicolor 4

- To make a print – each film was copied onto a light-sensitive gelatin film strip
- Soaked in a dye bath of the complementary color
- Images transferred to B&W film with sound track prerecorded soaked in mordant solution
- Color was rich and natural
- Required very bright light – ASA 5

Becky Sharp 1935
Gone With The Wind
Signin’ In The Rain
Adventures Of Robin Hood
Joan Of Arc
Snow White
1942 Casablanca

Serious films were shot in Black and White through the 1940s
1950’s Kodak and Technicolor

- Kodak and Agfa had introduced films in 1930’s that recorded all three colors on a single strip
- Both were reversal films available for 8 and 16mm markets
- 1950 first Kodak negative film
- 1952 Kodak print film
- Used for making Technicolor prints
- Saved camera rental, greater versatility
- Technicolor does not fade – film fades quickly
Cinema Responds to Television

• In the 1950s color became a common medium accessed in peoples homes
• Cinema had a new competitor searched for ways distinguish
• Color television came into common use during the 1950s after 20 plus years

1941 Popular Mechanics

• Describes color television as the next big thing
How Is It Different Than Film?

• Broadcast medium—Does not record an image
  – Recording was afterthought (video tape – 1951)
• More a performance less an art
  – This has changed over the years
• 1946 RCA got into camera development
  – 1953 model at right
  – Based on video pick-up tube
Widescreen Formats

- In response to television in the home
  - More color; wider screens; stereo sound; 3D films
Cinerama

- Invented by Fred Waller
  - Had roots in the 1920s (*Napoleon* 1927), 1939 World’s Fair (*Vitarama*)

- Widescreen process that works by simultaneously projecting images from 3 synchronized 35mm projectors on deeply curved screen – 146 degree arc
  - Shoot with 3 camera sharing a common shutter
  - Required special theatres (tents)
  - Later replaced with a single camera and 70mm film
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"The biggest new entertainment event of the year." - LIFE
Panavision

• 1953: Robert Gottschalk and Richard Moore
  – Made anamorphic projection lens for wide screens
    • Technology from WWI for tank periscopes
  – Lenses adopted for cameras
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CinemaScope

• Shot and projected with anamorphic lenses
  – Created image with aspect ratio 2X that on the film itself
  – First film *The Robe* (1953) Richard Burton, Jean Simmons
Superpanavision (70mm film)

- Ben Hur 1959—large commercial success
- 1962 *Mutiny on the Bounty* way over budget
  - MGM liquidated their assets to cover costs
  - Panavision acquired MGM’s camera equipment division
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Technicolor Demise

• Strategic error in moving to 3D camera
  – 6 film strips simultaneously – heavy and unwieldy
  – Only 2 films made

• Business error – not licensing technology
  – Prints had to be made in their labs
  – Slow to turn them out
  – Cameras were rented
  – Panoramic formats

• 1974 – last US movie
  *The Godfather Part II*
  – 1975 US plant closed
  – European plants closed
  – 1990 China plant closed
Life After Death

- Technicolor company outlived the process
  - Video and audio duplication
  - Sold several times
  - Process revived for archival value
- 1997 – reintroduced for cinema
  - People value the look, rich colors, and fade resistance
  - Now part of French group Thomson
  - Discontinued dye transfer in 2002
- Now film makers digitally imitate the look
Digital Cinema

Cinema of the new millennium
Cinema Resolutions

- 1997 4K Dalsa sensor
- 4096 (4046) x 2048 (8.2M) fills a 35-mm frame
- Allows use of existing lenses
- Sensitivity of about ASA 400

4K CMOS sensor
Digital Cinema Camera

- Full frame 4, 6, 8K CCD/CMOS
  - Red camera link
- Adjustments for
  - Gain, Knee, Slope
- 16 stops of exposure latitude
- 0-36 selectable frame rate
Could not have been made on film?
Current Projector Approaches

- **3/6 laser cinema projectors** – state of the art
  - Sony, Cristie, Barco
  - Optically addressed LCDs
  - Digital light processing

- 60,000 Lumens – 105 foot wide screen
  - Adjustable brightness

- Can use non-reflective screens – no hot spots

- $\sim$ $165K
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Cinema Olympia Paris