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OpenColorIO Configs, HDR/SDR Views, and ACES-Aligned Look Design for Japanese 2D Animation

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Preserving Creative Intent Across Digital Production and Film Remastering

- **Case 1:** Starting from P3-D65 / gamma 2.2 SDR artwork, we designed a **single HDR master and an SDR view**.
- **Case 2:** Starting from film scans, we reconstructed **the print-derived color-formation process**, designed SDR and HDR looks, and later translated the model into **ACES Look Transforms**.
- **Common question: What should be transformed**, **what should be preserved**, and **what must be explicitly defined** by the production?

Motivation and Conclusion First

From production-specific solutions to reusable shared knowledge

OpenColorIO and ACES provide a **powerful shared foundation** for color-space conversion, display rendering, and consistent views. Productions still need to define project-specific requirements, including:

- ***what the input actually represents***
- ***which relationships in the approved picture must be preserved***
- ***whether each operation should run in a linear, gamma-encoded, log, or density domain***
- ***whether operations with the same name perform the same calculation in different DCC applications***
- ***where non-portable processing should be baked, and which assumptions must be documented***
- ***how incomplete records and evidence should be separated into facts, inferences, and creative decisions***

Transform portability alone does not guarantee processing or operation portability.

This talk presents edge cases, evidence, and production decisions from two projects as practical feedback that can be translated into shared requirements, tests, and documentation.

Two Cases, Two Different Starting Problems

Each case presented a different challenge in defining a "correct transform."

Case 1 — The input and approved appearance were known

- The source was P3-D65 / gamma 2.2 display-referred artwork with approved SDR brightness and color relationships.
- The production required one HDR master while preserving established compositing behavior.
- The evaluated standard rendering paths did not meet both requirements for this production: preserving the approved appearance and maintaining the established production operations.

Case 2 — The input interpretation could not be determined uniquely

- Original laboratory metadata and scan characterization were incomplete.
- Mapping Status M-like data to an ADX-like representation depends on film, scanner, and density-normalization conditions.
- One surviving record could not guarantee that all required transform conditions had been established.

Case 1 explored how to preserve a known picture.
Case 2 explored how to establish a defensible reconstruction from incomplete evidence.
In both cases, HDR was used to preserve or re-express the role of light traditionally introduced during photography.

What Must Be Defined Before the Transform

Source meaning, processing representation, and approved appearance must be examined separately

Source interpretation

- What **image state** is the source in, and what do its **code values** represent?
- Is it close to a raw scan, or does it already include correction or rendering?

Working representation and processing domain

- What are the gamut, transfer function, and numerical range?
- Which operations belong in linear-light, gamma-encoded, log, or density space?

Approved appearance and processing history

- Which picture was the **reference for creative approval**, and what processes formed it?
- **What must be preserved**, and **what may be extended** for a new delivery format?

**These aspects cannot be captured by a single label.
They must be defined separately before a transform is selected.**

Case 1

Case 1 | Production Architecture

Preserve P3-D65 / gamma 2.2 SDR artwork and extend newly added light into HDR

P3-D65 / gamma 2.2 SDR artwork

+

light / glow / optical-effect elements

↓

After Effects production environment
project-wide Working Color Space + custom OCIO config

↓

single linear-light P3-D65 OpenEXR HDR master

↓

shared HDR / SDR / no-tone-mapping views

↓

post-production grading and delivery

- Backgrounds, characters, and painted colors had already been designed and approved for SDR display.
- We did not create separate SDR and HDR productions; the SDR version was derived from **one HDR master**.
- HDR headroom was allocated mainly to **digital counterparts of traditional transmitted-light effects**: emission, glow, and optical effects.
- Production and post-production shared the **same views and tone-mapping context**.

Preserve the completed SDR artwork.
Extend the transmitted-light component.

Case 1 | Why the Evaluated ACES Paths Did Not Meet This Production's Requirements

A successful round trip does not necessarily provide the creative working representation required by a specific production

Path A — Inverse Output Transform

- ACES 2.0 made inverse and **round-trip behavior** substantially more practical than ACES 1.3.
- However, the inverse-transformed values were not necessarily a suitable base for After Effects **creative operations**.
- Whites, midtones, and effect response differed from the established P3-D65 / gamma 2.2 workflow.

Path B — Simple linearization + standard ACES Output Transform

- We linearized the artwork and viewed it through a standard ACES Output Transform.
- The resulting tone scale produced **midtone relationships** that differed from the **approved reference**, including those of characters and skin.
- Our requirement was to **keep most SDR artwork almost unchanged** outside the high-luminance region and **extend mainly the newly added light** into HDR.

The evaluated ACES paths were technically valid, but the resulting appearance and response under creative operations did not meet the requirements of this production.

Case 1 | Application Architecture and Processing Domains

After Effects and Nuke differed in architecture, processing domain, and viewing conditions

After Effects

- **One Working Color Space** was assigned to the entire project.
- Most animation compositing work was performed in **P3-D65 / gamma 2.2**.
- Selected operations could be moved into linear-light, but connecting multiple domains inside one **global working space** remained a design challenge.

Nuke / VFX

- The VFX team continued using its familiar **ACES linear-light workflow**.
- **Node-level transforms** made local changes of working representation easier.
- Artists worked through an **ACES SDR view on SDR monitors**, so high scene-linear values were not judged directly on an HDR display.

A handoff must communicate not only the global working space, but also the host application, view, and processing domain in which each decision was made.

Case 1 | Custom HDR/SDR Picture Formation

Preserve most of the SDR artwork and compress mainly the added HDR headroom

SDR artwork range

background / character / skin / painted colors

brightness relationships remain almost unchanged

HDR headroom

emission / glow / optical effects

compressed mainly in the upper range for SDR output

Custom SDR mapping

- Convert RGB into a representation with a scalar value component.
- Apply a spline curve to that value component.
- Outside the high-luminance region, leave the low-to-mid range almost unchanged.
- Compress mainly the emissive components that exceed the SDR limit.

The purpose of this tone mapping was not to reshape the entire HDR image into a new cinematic rendering.

Use the completed SDR artwork as the reference,
and map the added HDR light back into the SDR delivery.

Case 1 | Same “Screen,” Different HDR Result

Matching color transforms do not by themselves guarantee identical numerical behavior for similarly named operations across applications

After Effects (Screen)

A + B − AB

Nuke (Screen)

if 0 < A < 1 and 0 < B < 1: **A + B − AB**
otherwise: **max(A, B)**

Example above 1.0

A = 5.0, B = 0.9

Nuke: max(5.0, 0.9) = **5.0**
AE: 5.0 + 0.9 − 5.0 × 0.9 = **1.4**

- Operations may appear similar in the 0–1 range but **diverge significantly for HDR values**.
- Different channel-wise value collapse can produce **major hue shifts**.
- In production, we observed a high-luminance **blue element shifting toward green**.

Nuke behavior: Foundry documentation
After Effects behavior: observed in production testing

Case 1 | The Production Decision

We prioritized appearance stability over complete layer portability

Nuke / ACES-based VFX

↓

partially bake the look
containing non-portable operations

↓

handoff as
rendered image elements

↓

final integration in
After Effects / custom OCIO environment

↓

final review on
both HDR and SDR monitors

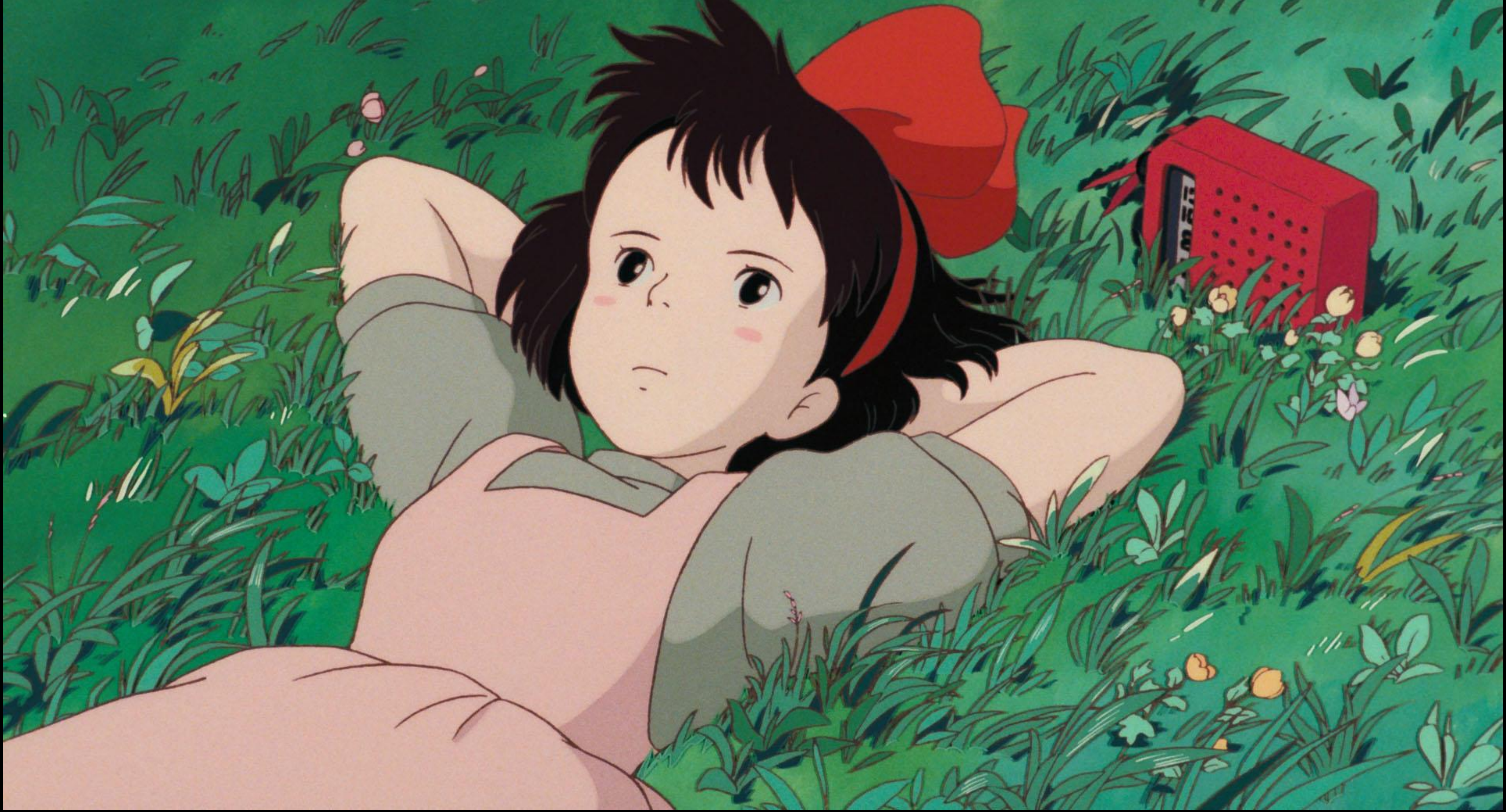
- The **“Add”** operation produced **more consistent results** across applications, but it could not provide the **required optical expression**.
- **“Screen”** was creatively useful, but it **did not reproduce consistently** across the **evaluated applications** for values above 1.0.
- We **baked** the non-portable part of the look and moved the **handoff boundary** later in the pipeline. The key question was **how much approved appearance had already been baked**—not the file format.

Add was **more consistent in our tests**, but not expressive enough.
Screen was expressive, but **not consistent across the evaluated applications for HDR values**.

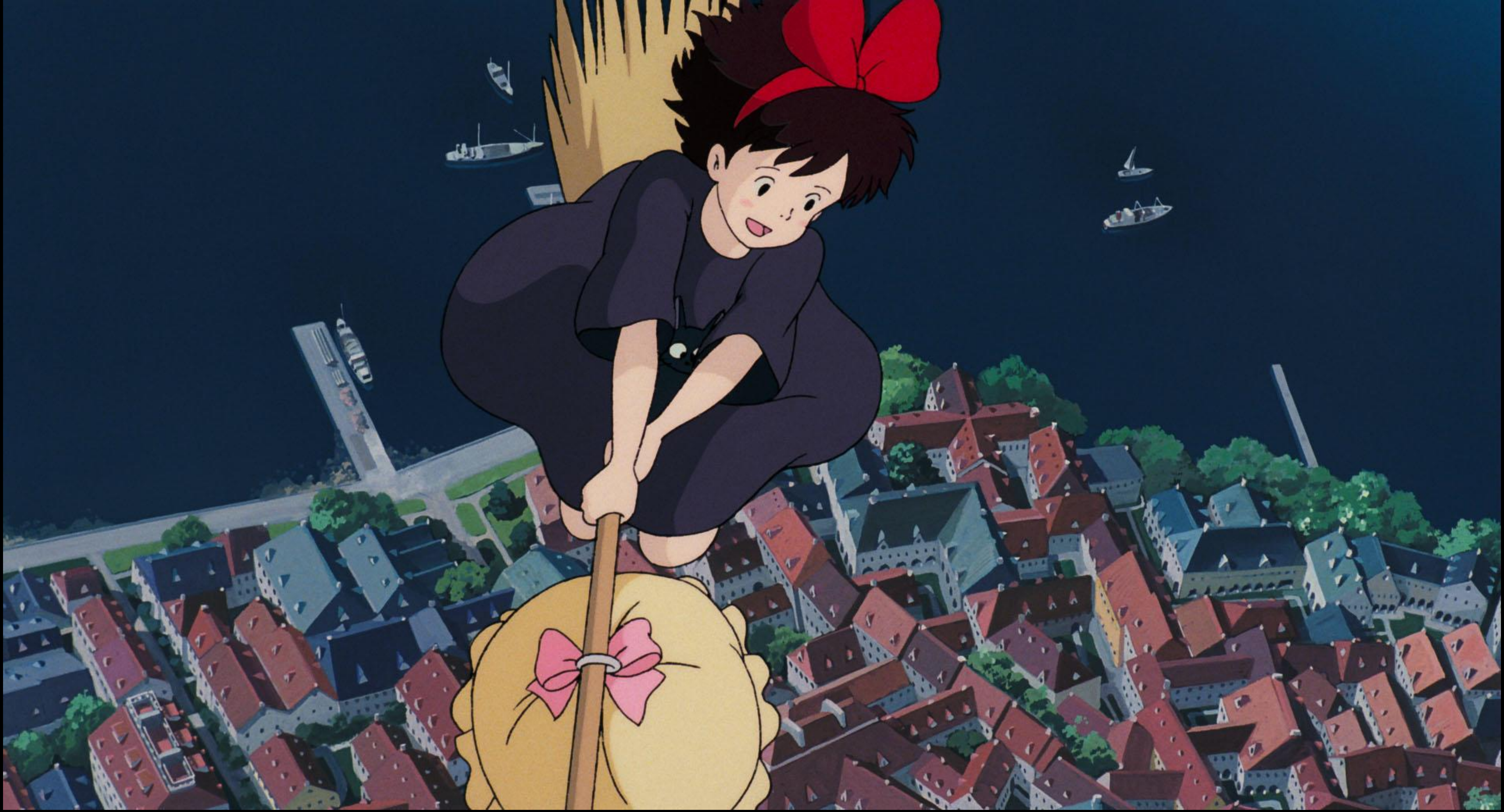
Case 2

Princess Mononoke

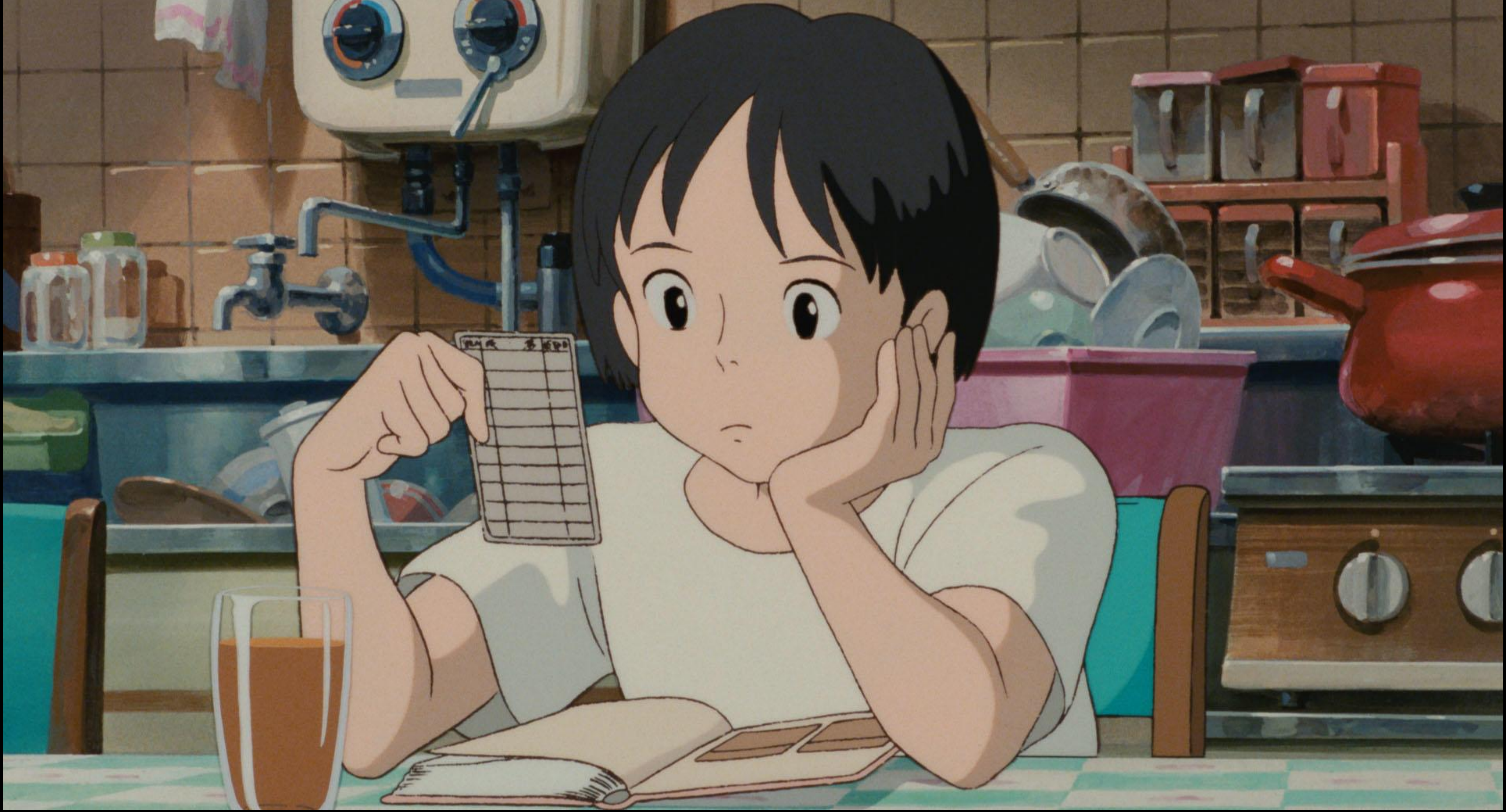
Princess Mononoke



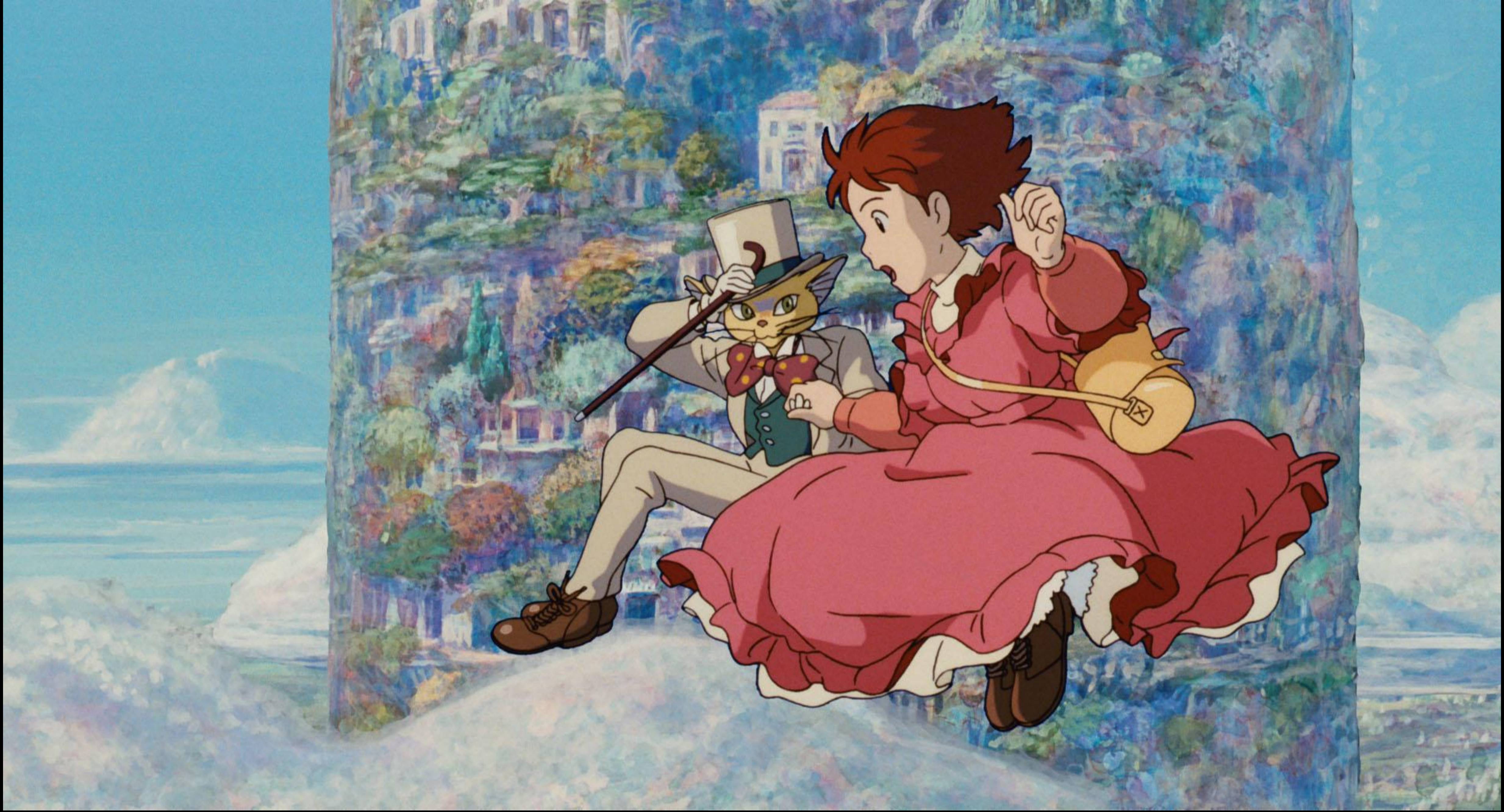
Kiki's delivery service



Kiki's delivery service



Whisper of the Heart



Whisper of the Heart

Case 2 | What Shaped the Approved Theatrical Picture

The approved picture was formed by the complete process from camera negative to theatrical projection

artwork / background
↓
recording onto camera negative
↓
film development
↓
print timing
↓
printing onto release-print stock
↓
CMY print dyes
↓
projection light and flare
↓
approved theatrical picture

- For the digital remaster, we did not treat **the scan data alone** as the grading target. Instead, the **approved theatrical appearance** served as the reference for the reconstruction.
- We modeled the path from **a camera-negative density representation** to **that approved theatrical picture**—through print timing, print characteristics, CMY dyes, and projection light.

We did not assume that the scan itself represented the final color intent.

Case 2 | Why Additional Records Would Not Necessarily Define One Correct Transform

Searching for records was important, but records alone could not guarantee a unique transform

Available evidence and its limits

- Original laboratory metadata and scanner characterization were incomplete.
- Further investigation might have recovered film, scan, or density information.
- However, mapping Status M-like data to an ADX-like representation depended on multiple conditions.

Influencing factors

- film type and spectral sensitivity;
- scanner response, calibration, and scanner-side correction;
- scan exposure, density normalization, cross-talk, and matrix assumptions;
- intended reference print and timing context.

Rather than treating **one surviving record or matrix as the answer**, we combined documentation, measurements, references, and expert evaluation to constrain a defensible transform and look.

The absence of metadata was not the only problem. The transform depended on conditions that could not be guaranteed by one surviving record.

Case 2 | Evidence-Constrained Reconstruction

We separated evidence by its level of certainty

Documented evidence

- ARRI documentation describing Status M-type and printing-density-type color tendencies.
- A historically documented film-specific Status M-to-ADX matrix and timing data.
- Published CMY dye information, including Kodak documentation.

Measured evidence

- The projection-light spectrum of our projector.

Inferred interpretation

- The scan was interpreted as Status M-like from its appearance and technical documentation.
- Starting from the documented matrix, we adjusted the 3×3 mapping, finalized it, and encoded it as a reusable CLF.

Interpretive constraints

- Surviving historical reference images.
- Evaluation by the cinematographer.

We treated the result as an **evidence-constrained reconstruction**, informed by documented sources, measurements, assumptions, timing data, and creative evaluation.

Technical plausibility and artistic validity were evaluated separately.

Case 2 | Film-Process-Informed Look Design

For this work, a parameterized film-process-informed model provided the flexibility needed beyond a single fixed LUT

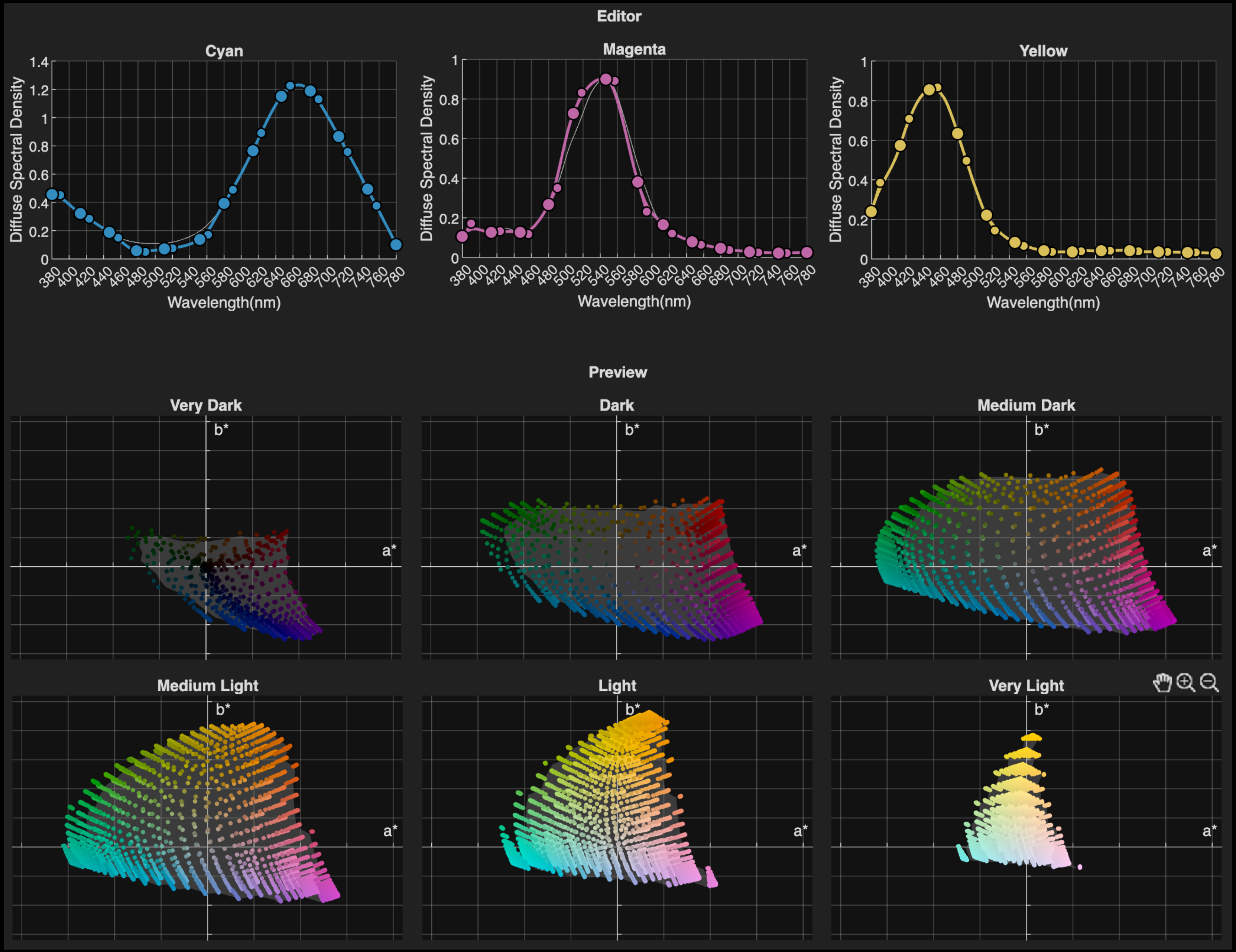
ADX-like density representation
↓
print timing values
↓
characteristic curves
↓
CMY dye spectral transmittance
↓
measured projection-light spectrum
↓
projection flare / viewing adjustments
↓
target RGB color space

The model provided film-process-informed controls while preserving room for creative judgment.

Creative decisions could be expressed through controls tied to film color formation:

density, timing, CMY dyes, and projection light.

The model provided film-process-informed guardrails for creative look design.



internal MATLAB-based authoring tool

Case 2 | Creative HDR Extension

Preserve film-derived color formation while selectively relaxing the print constraint in the highlights

Historical print behavior

- Color formation based on CMY dyes and projection light.
- Highlight compression produced by print characteristics.
- Picture formation converging toward a finite theatrical luminance.

HDR remastering behavior

- **Preserve film-derived color behavior.**
- **Selectively relax print compression** in the high-luminance region.
- **Re-express high-exposure information**—including transmitted-light effects—recorded on the camera negative but compressed by the print.

The goal was a **creative HDR extension** rooted in the reconstructed film color-formation process: **preserving its color-forming guardrails** while **selectively extending the high-luminance region** for a modern display medium.

Reconstruction established the color-forming structure.
The HDR extension selectively relaxed the print-imposed luminance constraint.

Case 2 | ACES-Aligned Look Design

From a production-specific print model to portable ACES-to-ACES Look Transforms

production-specific print-color model

⬇

internal MATLAB-based authoring tool

⬇

ACES-to-ACES Look Transforms

⬇

portable CLF artifacts

⬇

ACES Output Transform

- Production used a custom print-emulation model for film-derived color formation and HDR extension.
- **Later R&D translated the model** into ACES-to-ACES Look Transforms, each reconciled with the corresponding **ACES 1.3** or **ACES 2.0** display rendering.
- The results could be exported as **portable CLF artifacts** for use in compatible ACES workflows.

In this talk, "ACES-aligned" refers to translating a production-specific look model into portable ACES-to-ACES transforms that are reconciled with the corresponding ACES display rendering.

Conclusion | Practical Steps Toward Shared Knowledge

Production experience becomes reusable when it is made visible, testable, and traceable.

- Synthetic HDR tests
- Technical notes
- Shared handoff checklists
- Provenance templates
- Evaluation requirements

An open question for the community

When a production-derived Look Transform is reused beyond one project, what validation, documentation, preview material, and provenance should accompany it?

The goal is to make the assumptions underlying these decisions visible, testable, and traceable—so that the resulting knowledge can be reused responsibly.

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