# FINDING THE ROMANCE WITH FIJI

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## BACKGROUND

Image processing and analysis has been used in the sciences since before the advent of the personal computer, beginning as early as the 1920s (Gonzalez & Woods, 2002, p. 3-4). The need to improve image quality spurred the beginnings of scientific image processing, in which images are prepared through digital manipulation "for the measurement and analysis of the features and structures that they reveal" (Russ & Neil, 2016, p. xiii). While scientific fields such as medical research, space programs and astronomy were among the first to make use of this software, (Gonzalez & Wood, 2002, p. 5-6), and due to this modern software is geared towards scientific research, it is seeing growing use in other areas such as the arts and humanities. In this study, digitized cover images of fragile mass market paperbacks are used in an exploration of the software Fiji, a build of the image processing and analysis tool, ImageJ. How can Fiji be used in the analysis of non-traditional, non scientific images? What strengths does Fiji have? What weaknesses in analysing these images?

## WHY FIJI/IMAGEJ?



*Figure 1.* Fiji logo. Adapted from "Case One Study Results," by J. Schindelin et al., 2012, Fiji. Retrieved from https://fiji.sc/. Copyright 2012 by J. Schindelin et al.

Fiji/ImageJ was chosen due to its prevalence in the history of image processing and analysis tools, and its open source nature. Its predecessor, NIH Image, was developed as a "general-purpose extensible image-analysis program that could be used by anyone who wanted to capture, display and enhance images" (Schneider, Rasband & Eliceiri, 2012, p. 672). ImageJ has continued this open source, open access tradition, and Rasband has encouraged users to build on the original tool through the creation of plugins and scripts, and community discussion through forums and mailing lists (p. 672).

Fiji was specifically chosen due to its user-friendly nature. It offers automatic updates, a suite of already-installed analysis plug-ins contributed by users from around the world, and extensive documentation. It is a good starting point for researchers who are delving into image processing and analysis for the first time.

## REFERENCES

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## WHERE TO START?

Prior to jumping into ImageJ, the collection of images need to be analyzed. As Manovich states, the images themselves are dependent on the kind of research one wants to accomplish, as the quality of the images tie into and can greatly affect one's research questions. Continuing Manovich's discussion on the matter, he states for example that "if we want to investigate larger patterns and cultural trends which manifest themselves only across large image collections... the presence of scanning artifacts, color inaccuracy, and other problems resulting from digitization of these images may not affect our results" (Manovich, 2011, p.39).

One reasonable way to begin exploring ImageJ is through colour analysis. Prior knowledge of colour theory and space is necessary in approaching this field of research, but with this software colour can easily be converted into measurable data, and exported into statistical analysis software. It can then be compared to the book genres within the collection or other metadata, or arranged on a chronological scale to view changes in aesthetics over time. Several user-friendly plugins that offer measurements of colour features will be discussed, as they were found to be the most reliable in working with scanned book images. Examples of visualizations That these plugins produced will be given Using a book cover from the Harlequin Collection at the University of Alberta's Bruce Peel Special Collections. Challenges that have arisen while using ImageJ will also be explored.



*Figure 2.* Book cover. Adapted from "The Manatee," by N. Bruff, 1949. Copyright 1949 by Harlequin Enterprises.
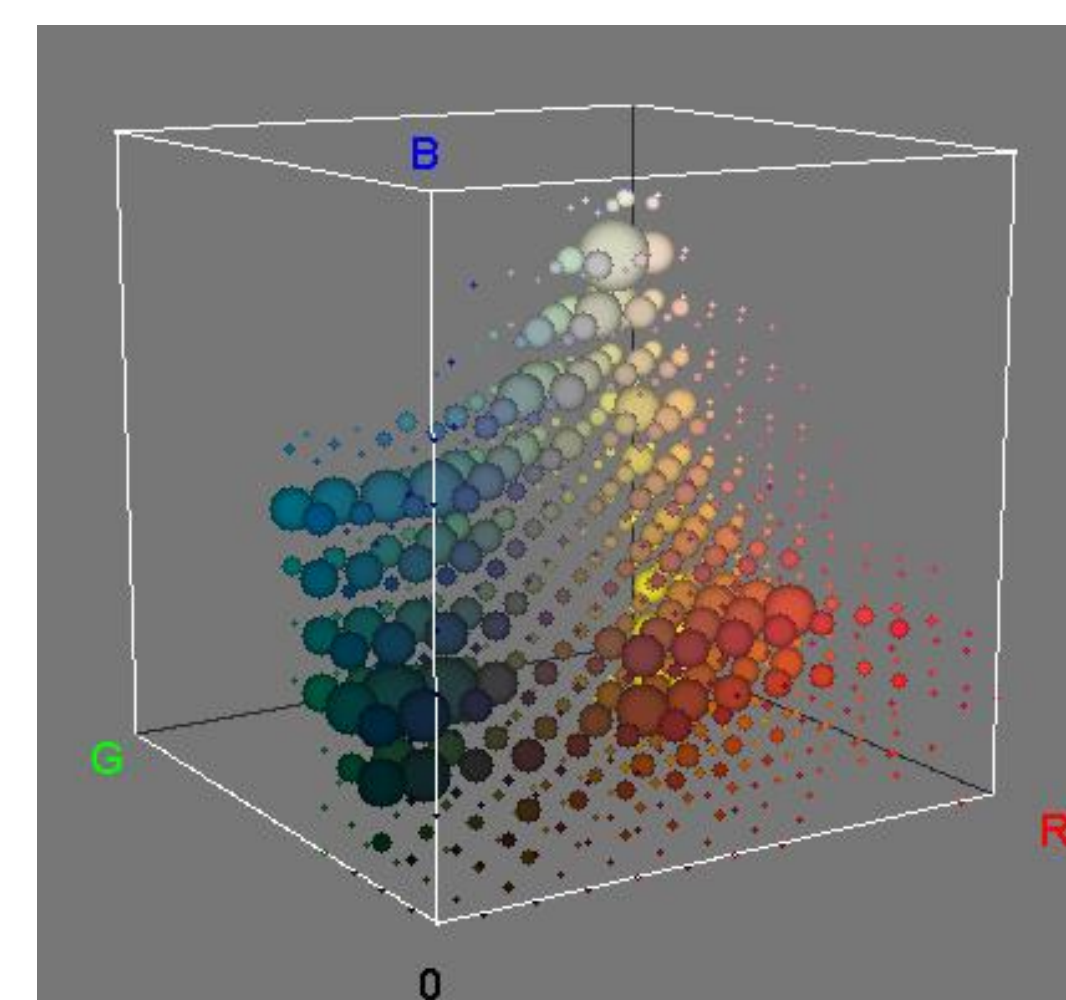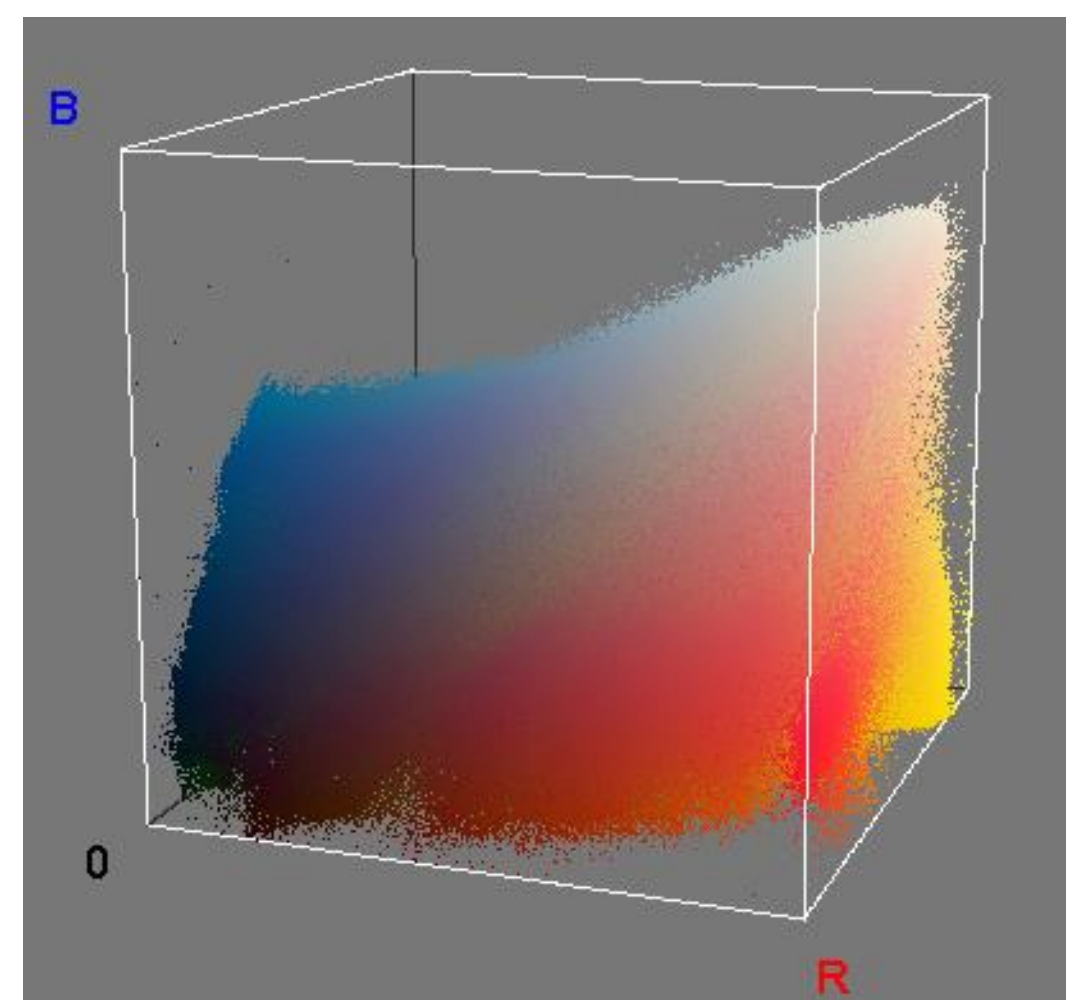


*Figures 3 and 4.* RGB visualization and RGB histogram visualization using Color Inspector 3D.

## ANALYSIS TOOLS

**Color Inspector 3D:** Provides a 3D visual representation of the colour distribution of an image, with options to allow the colour to be weighted independently or by their frequency of occurrence (Barthel, 63-64). This plugin can also perform colour quantization, in which the number of colours in an image are reduced but the image is maintained as much as possible, to produce the frequencies of either 236 or 701 colours.

**RGB Profiles:** A plugin that provides a graph of pixel intensities for each colour channel, "where the X-axis represents the horizontal distance through the selection and the Y-axis the vertically averaged pixel intensity" (Ferreria & Rasband, 2012). The results table also provides the mean and standard deviation for each channel, and one can export a csv list of each pixel's values. These measurements are highly useful due to the different forms of data output. For example, multiple graphs can be compared visually, and using the csv list percentages of a certain colour range can be determined.
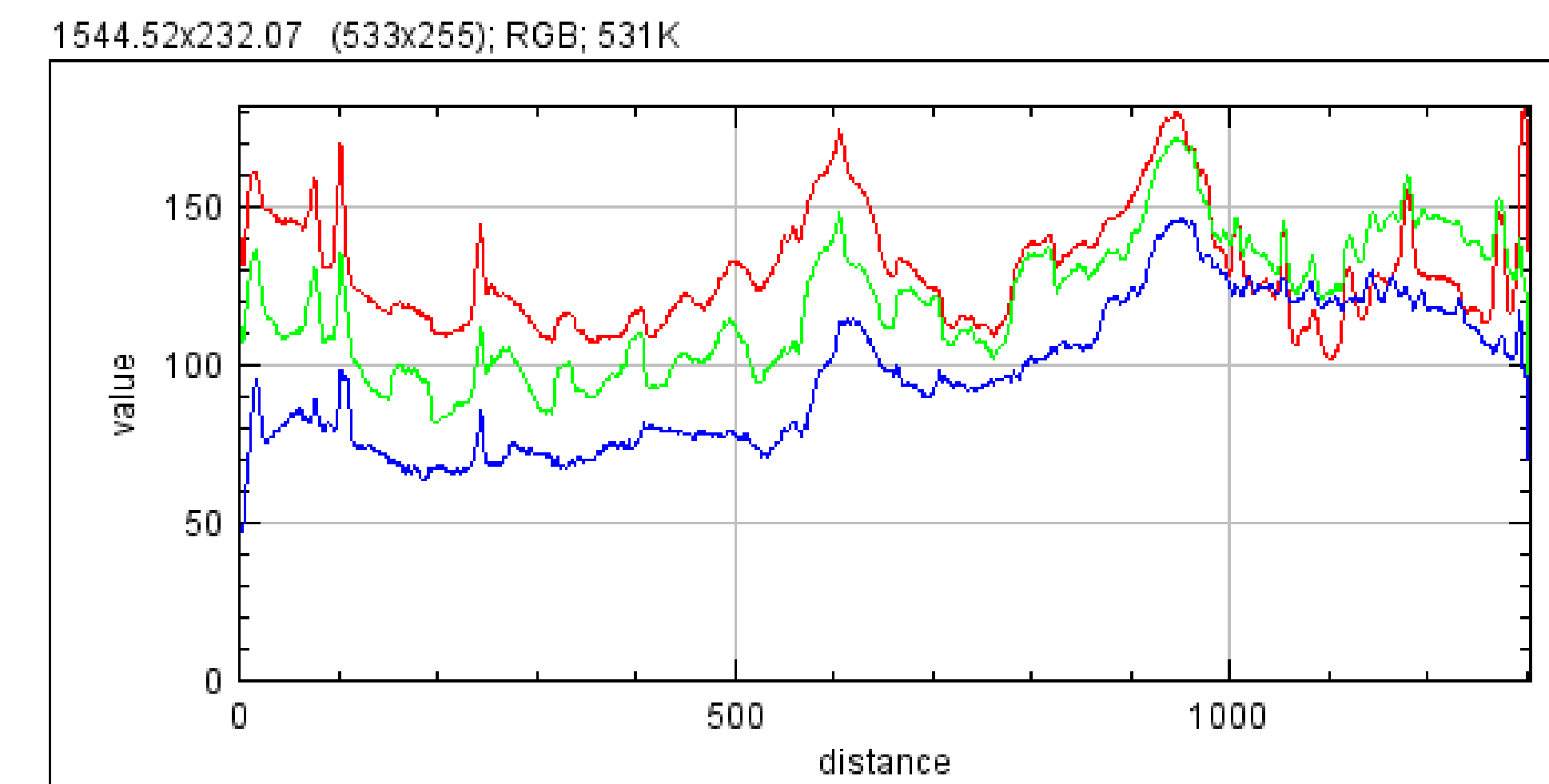


*Figure 5.* RGB Profiles colour graph.

**ImageMeasure:** A macro that measure the standard deviations and medians of brightness, saturation and hue of an image. Images are first converted into grayscale for brightness measurements (Manovich, 2011, p.31).

**Imageplot:** Creates a scatterplot visualization from a set of images according to new or existing metadata, or features extracted by the plugins ImageMeasure and ImageShapes (Manovich, 2011, p.2).

## CHALLENGES TO CONSIDER

ImageJ itself has several specific downsides. Uniformity of colour is important in colour analysis, and while some software also provides colour calibration tools, ImageJ does not. Its installation methods for user-created tools is not ideal, as there are multiple methods based on whether it's an installation of a plugin, or running a macro or script. Occasionally plugins would not download properly, were corrupted, or for unknown reasons would simply not run. Additionally, plugin/script/macro locations can all vary in the large amount of menus, which may overwhelm new users. Unfortunately, the context for most guides, tutorials, and discussions are for scientific images, which can be difficult to adapt to the needs of humanities images if a researcher is not examining chemical composition and texture. Following this, plugins are generally limited by low bit depth, such as only allowing for grayscale or 8-bit, when having a higher bit depth for humanities-related images typically better. ImageJ is a powerful tool, as long as users take the time and effort to learn it quirks, and understand its limitations.