# Limb

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Display Limb Along Polyline

Assume a polyline along the limb. For each line segment of the polyline, apply a rotation to the x-axis. Extend this rotation to a rectangle parallel to the line segment.
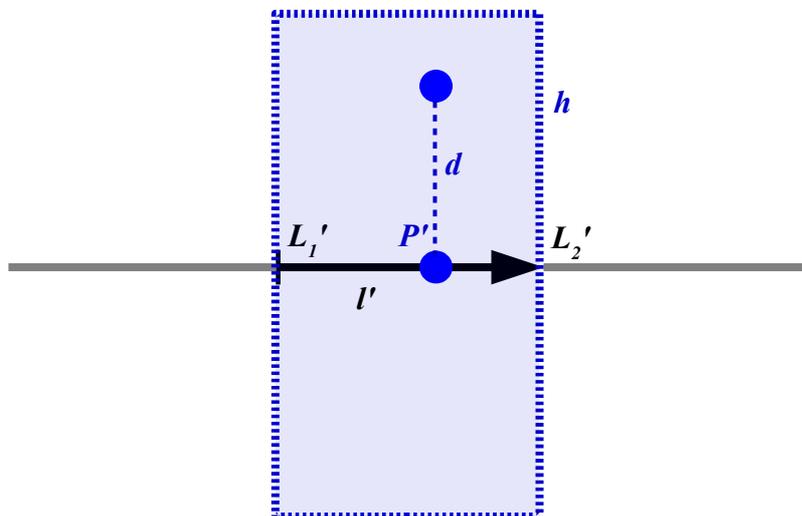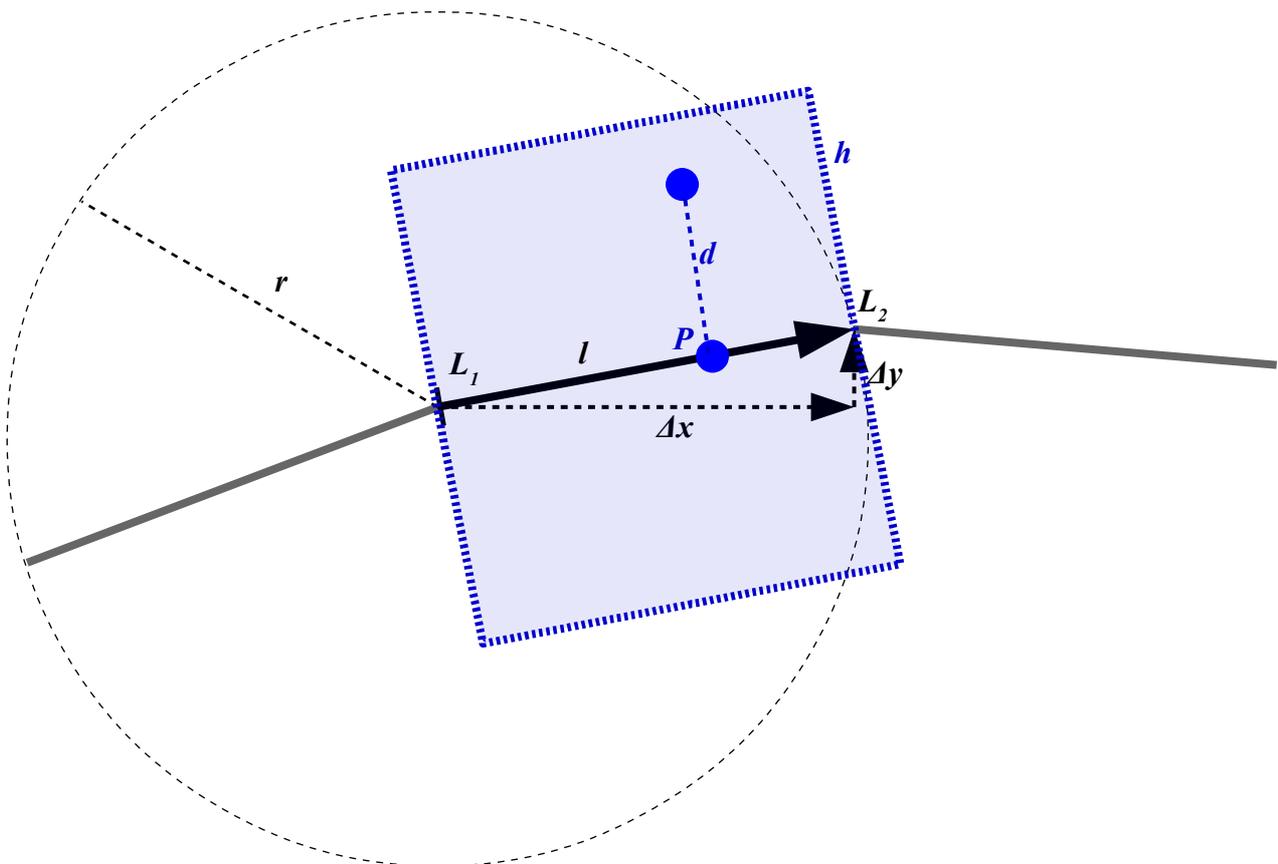
Apply some appropriate scaling along the x-axis.

For the value at the source position, use interpolated color values by bilinear interpolation of the four nearest source pixels.

When plotting overlapping areas, sum up weights, and calculate weighted means.

Choose polyline fragments short enough, such that a more accurate decomposition of the source limb into trapezoids instead of rectangles isn't required for practical purposes.

Example

This example is derived from JunoCam image JNCE_2017086_05C00106_V01. Input for limb rectification is a decompanded and square-root encoded (gamma = 0.5 with respect to linear radiometrical values) rendition that doesn't use trajectory data nor a shape model, but just assumes the camera to look to infinity. The projection is otherwise cylindrical equidistant with the spacecraft spin axis used for the axis of the cylinder. Here a 10-fold reduced image and the polylines along the detected limb:
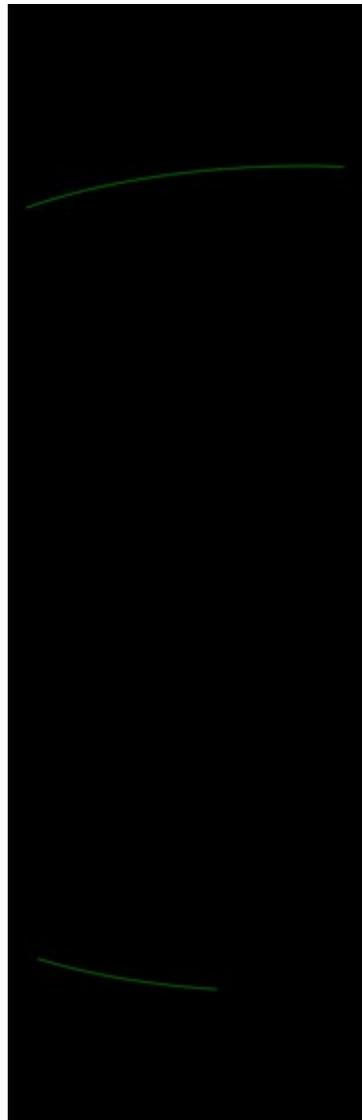
A crop of the "upper" limb
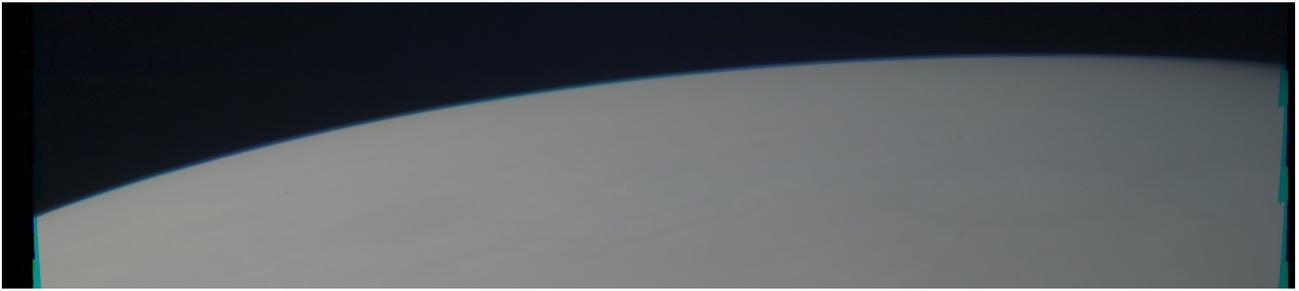
and the polyline along the detected portion of the limb
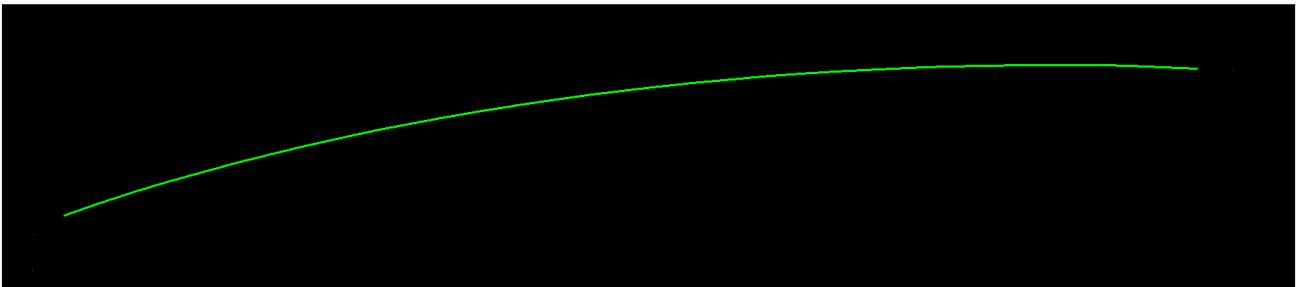

Rectified version of the detected limb fragments:

JNCE_2017086_05C00106_V01

Plot Diagrams of Cross Section
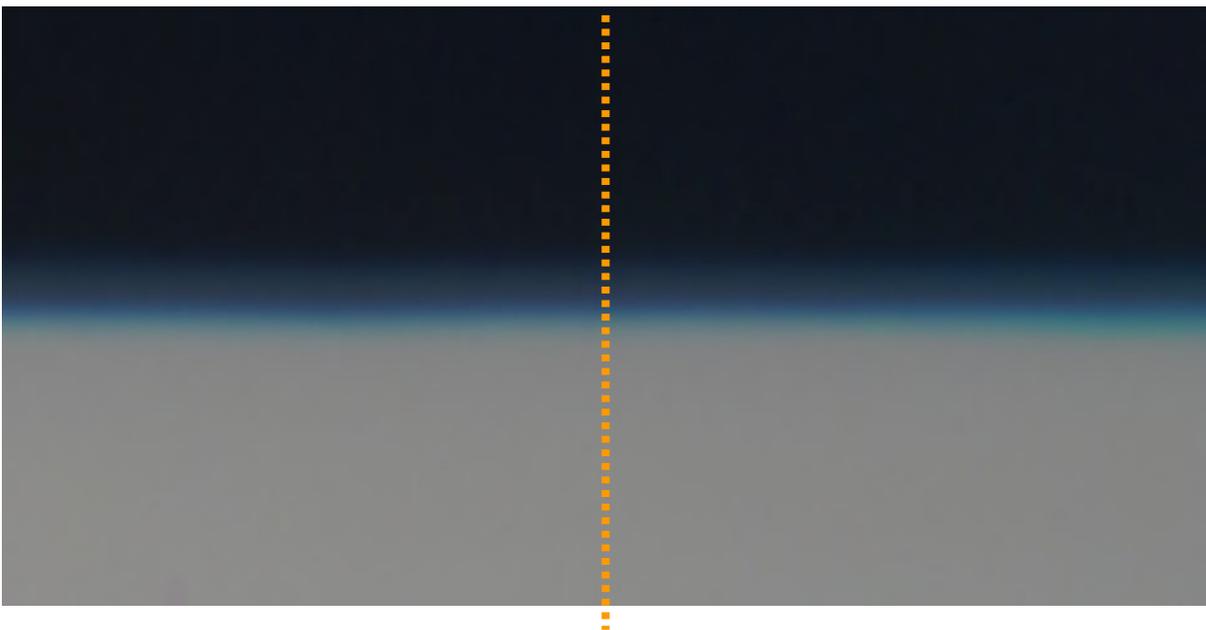
For selected positions along the x-axis of the rectified limb, loop along a line perpendicular to the x-axis in steps of constant length, and for each of the three color channels, calculate the difference of

the color value between positions of consecutive steps:
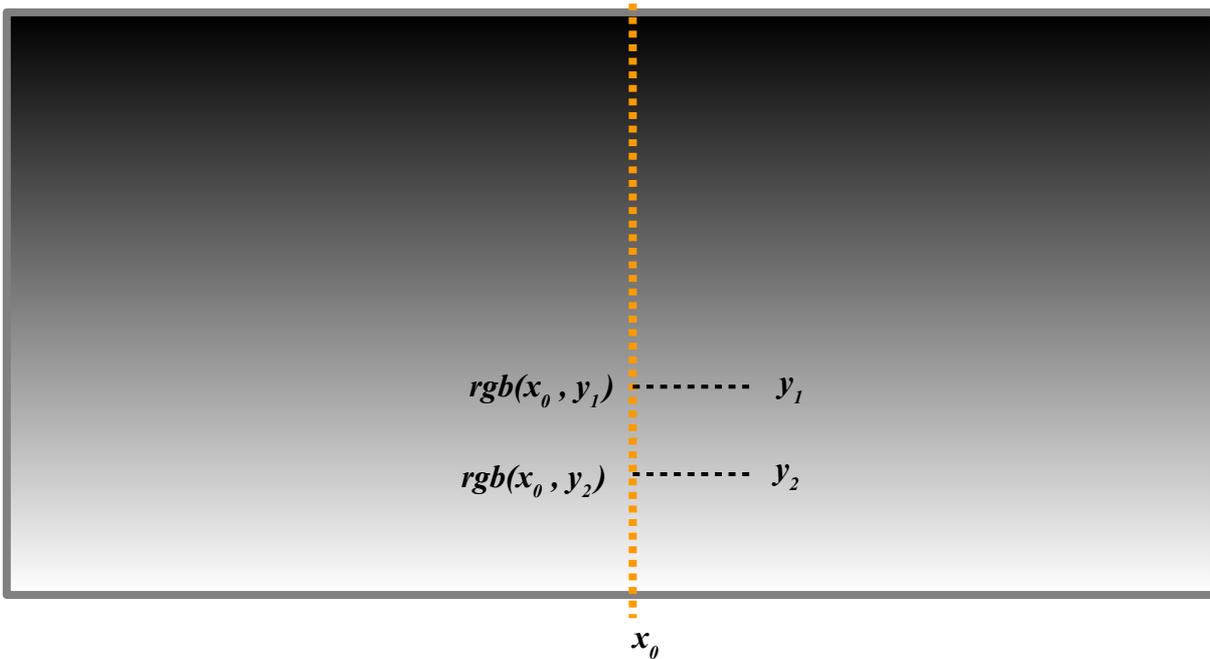
This corresponds to a numerically determined partial derivative of the square-root encoded brightness values with respect to the axis perpendicular to the limb.

$$\frac{\partial rgb(x_0, y)}{\partial y}((y_1 + y_2)/2) \approx \frac{rgb(x_0, y_2) - rgb(x_0, y_1)}{(y_2 - y_1)} \quad .$$

Adjust the sign, if appropriate for plotting the diagram.

Below an example diagram in histogram notation:
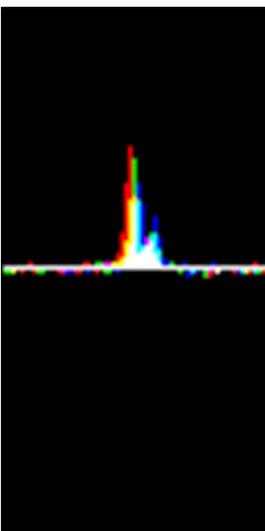
The diagrams for each color channel are plotted in the color of the channel.

Searching for Limb Fragments

For a given search radius define a grid step of about half the search radius and scan over the input image with this grid step in x and y direction. For each grid point, try to identify, mark, and store a limb fragment as a polyline. Discard very short limb fragments.

For a given position in the input image, investigate a regular n-gon, with n~32. For consecutive

nodes of the n-gon, determine the slope of the grey values along the edge in-between. Store the steepest slope together with the position of the next node of the n-gon. Define the node with the steepest slope next to it as a point on a limb fragment, if a given trigger value for the amount of the slope is exceeded.

With a point on the limb identified, continue searching at that new point. Add limb points to the polyline as long as it exceeds the trigger value of its slope of grey values.

For a new limb point candidate check for proximity to a prior point along the polyline in order to avoid self-overlapping polylines.

For the immediate dozen or so predecessors of the new limb point candidate, check instead for a too acute angle, in order to avoid folding the polyline back.