Alfa.R code reasoning

I first created synthetic data that would effectively demonstrate how different patches on fish can be distinguished using hyperspectral measurements. The **varied_spectra.csv** file was designed to contain five measurements per patch type, simulating natural variation while maintaining distinct spectral signatures and characteristic spectral patterns that mirror biological reality.

The code implementation centres around the spectral angle calculation function, which implements the formula from the paper: $\alpha = \cos^{-1}(\Sigma XY/\sqrt{}(\Sigma(X)^2\Sigma(Y)^2))$. This calculation is crucial for identifying the most representative measurement for each patch type by finding the measurement closest to the mean. The function returns angles in radians, providing a standardized measure of similarity between spectra.

The visualization component produces two distinct plots. The first displays all measurements and means, with individual measurements shown as thin lines and means as thicker lines in corresponding colours. This visualization demonstrates the variation within patches while maintaining clear distinction between patch types. The second plot shows only the representative spectra (those closest to the mean), providing a cleaner visualization for quick comparison between patches.

The data processing flow moves systematically from reading the CSV file through plotting all measurements, calculating means, finding representative spectra using spectral angles, and finally creating the comparative plots. The implementation uses nested loops for efficiency, with the outer loop processing each patch type and the inner loop handling individual measurements. The grep function identifies relevant columns for each patch type. In the code, the wavelength column positioned first for easy reference.

Colour choices in the visualization match the actual patch colours for intuitive interpretation, with line thickness differentiating means from individual measurements. The y-axis range of 0-100% covers the full possible reflectance range, while the wavelength range matches the visible spectrum. This approach provides a practical demonstration of the spectral analysis methods described in the Piranha paper, allowing both examination of variation within patches and comparison between different patch types.