

Functional Specification for Agglutination Pattern Analysis Package

1. Background

Agglutination assays are widely used in medical diagnostics and research to detect and quantify various substances in biological samples. Currently, analyzing agglutination patterns and determining concentrations from images is often done manually, which is time-consuming and subject to human error. Additionally, accurate interpretation of agglutination patterns requires extensive training and experience, making the process heavily dependent on skilled personnel availability.

This package addresses these challenges by automating the analysis of agglutination patterns using machine learning, providing rapid and consistent concentration predictions from agglutination images.

2. User Profile

Primary Users: Laboratory Technicians

- Domain Knowledge:
 - Familiar with agglutination assays and their interpretation
 - Understand concentration measurements and scientific notation
 - Regular experience with laboratory procedures
- Technical Skills:
 - Basic computer literacy
 - Can operate standard laboratory software
 - No programming knowledge required
 - Comfortable with graphical user interfaces

Secondary Users: Research Scientists

- Domain Knowledge:
 - Advanced understanding of agglutination principles
 - Deep knowledge of experimental design
 - Experience with data analysis
- Technical Skills:
 - Proficient with scientific software
 - May have basic programming experience
 - Familiar with data analysis tools
 - Can interpret complex analytical results

3. Use Cases

Use Case 1: Quick Concentration Prediction

Objective: Laboratory technician needs to determine the concentration of a sample from an agglutination image.

Interactions:

1. User launches the GUI application
2. User clicks "Upload Image" button
3. User selects an agglutination pattern image from their computer
4. System displays the uploaded image
5. System automatically processes the image and displays predicted concentration
6. User can save the results, including:
 - Original image
 - Predicted concentration

Expected Outcome: User obtains concentration prediction in scientific notation (e.g., $1.00e-8$)

Use Case 2: Batch Analysis for Research

Objective: Research scientist needs to analyze multiple samples for a study.

Interaction:

1. User prepares a directory of agglutination images
2. User runs the training script with appropriate parameters

```
```bash
python main.py --model ResRF --batch_size 32
```
```
3. System processes all images and generates:
 - Concentration predictions for each image
 - Statistical analysis of results
 - Visualization of prediction patterns
4. System saves results to a structured directory:
 - Individual predictions
 - Summary statistics
 - Performance metrics
 - Visualization plots

Expected Outcome: User receives comprehensive analysis results for multiple samples