Package 'grayleafspotr'

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Title Quantitative Analysis of Gray Leaf Spot Colonies from Plate Images

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Description Quantitative phenotyping of gray leaf spot (Magnaporthe oryzae) fungal colonies grown on petri dishes. The package segments colonies from time-lapse plate photographs using a bundled SmallUNet deep-learning model, extracts morphometric and texture features (area, eccentricity, crack coverage, radial profile), and provides tidy result objects together with template ggplot2 visualisations. Python dependencies are managed automatically through basilisk; no manual environment setup is required.

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BugReports https://github.com/rotsl/grayleafspotr/issues

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`grayleafspotr-package` *Gray Leaf Spot Package*

Description

Self-contained R tools for gray leaf spot analysis, raw exports, and plotting. The package is intended to be used from RStudio and developed with devtools.

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See Also

Useful links:

- https://rotsl.github.io/grayleafspotr
- https://github.com/rotsl/grayleafspotr
- Report bugs at https://github.com/rotsl/grayleafspotr/issues

as_grayleafspot_growth_data

Coerce a grayleafspot run object to a tidy data frame

Description

Extracts the results table from a `grayleafspot_run` object and normalises column aliases so that downstream plotting helpers see a consistent schema.

Usage

```
as_grayleafspot_growth_data(x)
```

Arguments

`x`	A `grayleafspot_run` object, a plain `data.frame` / `tibble`, or a list with a `$results` element.

Value

A `tibble::tibble()` with one row per image.

Examples

```
run <- example_grayleafspot_results()
as_grayleafspot_growth_data(run)
```

example_grayleafspot_dir

Path to the bundled example run directory

Description

Resolves the installed location of the small example run shipped under `inst/extdata/example/` (falling back to the in-source path during development, before the package has been installed).

Usage

```
example_grayleafspot_dir()
```

Value

A single character path.

example_grayleafspot_results *Load the built-in example grayleafspot run*

Description

Returns the small example run shipped with the package under `inst/extdata/example/`. Useful for exploring the plotting helpers without needing to run the analysis pipeline.

Usage

```
example_grayleafspot_results()
```

Value

A `grayleafspot_run` object.

Examples

```
run <- example_grayleafspot_results()
```

grayleafspot_analyze *Analyze plate images with the SmallUNet pipeline*

Description

Calls the bundled Python pipeline, performs dish detection and SmallUNet segmentation on each image, and returns a `grayleafspot_run` object with tidy results and template plots.

Usage

```
grayleafspot_analyze(
  input_dir,
  output_dir = "outputs",
  filenames = NULL,
  plate_diameter_mm = 90,
  run_name = NULL,
  save_outputs = TRUE,
  verbose = TRUE,
  python = NULL,
  engine_model = "localunet"
)
```

Arguments

input_dir	Character. Path to the folder containing plate images (JPEG, PNG, BMP, TIFF, or WEBP). Images must include a day token in their filename (e.g. *_d04_* for day 4).
output_dir	Character. Base output directory. A timestamped sub-folder is created for each run. Defaults to "outputs".
filenames	Optional character vector. Names of specific image files inside input_dir to analyze. If NULL, all supported images are processed.
plate_diameter_mm	Numeric. Known petri dish diameter in mm (default 90).
run_name	Optional character. Human-readable suffix appended to the timestamped run folder name.
save_outputs	Logical. If FALSE, outputs are written to a temporary directory and deleted after the results are returned.
verbose	Logical. Print the saved run path to the console.
python	Optional character. Advanced override: path to a specific Python executable. Overrides GRAYLEAFSPOTR_PYTHON and basilisk.
engine_model	Character. Must be "localunet".

Details

Python dependencies are managed automatically through basilisk. No manual Python environment setup is required for normal use. The first call will download and configure the required packages (this may take a few minutes on a fresh installation). Subsequent calls use the cached environment.

Developers who maintain a local Python environment can bypass basilisk by setting the GRAYLEAFSPOTR_PYTHON environment variable to the path of their Python interpreter; this is not required for normal users.

Value

A grayleafspot_run S3 object with elements $run (manifest metadata), $results (per-image data frame), and $raw_results.

See Also

grayleafspot_run() for a simpler entry point returning raw JSON.

Examples

```
img_dir <- system.file("extdata", "testdata", "06FEB", package = "grayleafspotr")
run <- grayleafspot_analyze(img_dir, output_dir = tempdir())
```

grayleafspot_download_model

Download the SmallUNet segmentation model

Description

Fetches `best_area_w_0.7.pt` from HuggingFace and caches it using `BiocFileCache::BiocFileCache()`. On subsequent calls the cached file is returned immediately without re-downloading.

Usage

```
grayleafspot_download_model(force = FALSE, quiet = FALSE)
```

Arguments

`force`	Logical. Re-download even if a cached copy already exists.
`quiet`	Logical. Suppress progress messages.

Details

The function looks for the model in this order:

1. `models/best_area_w_0.7.pt` relative to the package root (development).
2. The `BiocFileCache` cache keyed under `grayleafspotr`.
3. Downloads from HuggingFace and adds it to the cache.

Value

Invisible character string: absolute path to the downloaded model file.

Examples

```
grayleafspot_download_model()
```

grayleafspot_model_path

Return the path to the SmallUNet model, downloading it if necessary

Description

Used internally by the analysis pipeline. If the model is not found locally, `grayleafspot_download_model()` is called automatically.

Usage

```
grayleafspot_model_path(quiet = FALSE)
```

Arguments

quiet	Logical. Suppress download progress messages.

Value

Character string: absolute path to best_area_w_0.7.pt.

---

grayleafspot_python_available

Check whether the Python ML dependencies are available

Description

When the default basilisk-managed environment is in use, this function returns TRUE as long as basilisk is installed (the environment is set up lazily on first pipeline run). When an explicit Python interpreter is configured via GRAYLEAFSPOTR_PYTHON or the python argument, the function probes that interpreter directly.

Usage

```
grayleafspot_python_available(python = NULL, engine_model = "localunet")
```

Arguments

python	Optional character. Path to a specific Python executable. If NULL and GRAYLEAFSPOTR_PYTHON is not set, the basilisk-managed environment is assumed available.
engine_model	Character. Currently only "localunet" is supported.

Value

Logical TRUE if the pipeline can run, FALSE otherwise.

Examples

```
grayleafspot_python_available()
```

---

grayleafspot_python_executable

Return the Python executable used by the grayleafspot pipeline

---

Description

This function is intended for **advanced use only**. Normal users do not need to call it — the pipeline resolves its Python environment automatically via basilisk.

Usage

```
grayleafspot_python_executable(python = NULL, engine_model = "localunet")
```

Arguments

python	Optional character. Path to a Python executable.
engine_model	Character. Reserved for future use; currently only "localunet" is supported.

Details

Resolves the Python interpreter in this priority order: the python argument, the GRAYLEAFSPOTR_PYTHON environment variable, the grayleafspotr.python option, and finally python3 / python from PATH.

Value

Character string: absolute path to the resolved Python executable.

Examples

```
tryCatch(
  grayleafspot_python_executable(),
  error = function(e) message("Python not found: ", conditionMessage(e))
)
```

---

grayleafspot_run *Run the gray leaf spot pipeline — simplified entry point*

Description

A streamlined wrapper around the SmallUNet pipeline. Python dependencies are resolved automatically via basilisk — no manual environment setup is required.

Usage

```
grayleafspot_run(
  input_dir,
  output_dir,
  run_name = "run",
  engine_model = "localunet",
  plate_diameter_mm = 90
)
```

Arguments

input_dir	Character. Path to the folder containing plate images.
output_dir	Character. Directory to write outputs into (created if absent).
run_name	Character. Human-readable label for the run (default "run").
engine_model	Character. Must be "localunet".
plate_diameter_mm	Numeric. Known petri dish diameter in mm (default 90).

Details

Workflow:

```
library(grayleafspotr)

res <- grayleafspot_run(
  input_dir  = "path/to/images",
  output_dir = "outputs",
  run_name   = "trial_01"
)
res$results   # per-image feature table
```

Advanced: developer Python override:

Set `GRAYLEAFSPOTR_PYTHON` in `~/.Rprofile` to use a specific interpreter (e.g. a local `rvenv_arm_311`). This is **not needed** for normal use.

```
# ~/.Rprofile — developer only
Sys.setenv(GRAYLEAFSPOTR_PYTHON = "/path/to/rvenv_arm_311/bin/python")
```

Value

A named list parsed from the pipeline JSON output, containing `$results` (per-image feature records) and `$run` (manifest metadata).

See Also

`grayleafspot_analyze()` for the full-featured interface returning a `grayleafspot_run` S3 object with plotting helpers.

Examples

```
img_dir <- system.file("extdata", "testdata", "06FEB", package = "grayleafspotr")
result <- grayleafspot_run(img_dir, tempdir())
```

`plot_colony_expansion` *Plot colony expansion over time*

Description

Draws equivalent colony radius (mm) against time (days) as a line + point plot using the `ggplot2` theme_minimal style.

Usage

```
plot_colony_expansion(x)
```

Arguments

`x`	A `grayleafspot_run` object, data frame, or list accepted by `as_grayleafspot_growth_data()`.

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_colony_expansion(run)
```

`plot_feature_heatmap` *Pearson correlation heatmap of numeric morphology features*

Description

Pearson correlation heatmap of numeric morphology features

Usage

```
plot_feature_heatmap(x)
```

Arguments

x	A grayleafspot_run object or data accepted by as_grayleafspot_growth_data().

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_feature_heatmap(run)
```

`plot_grayleafspot_overlay`
Overlay detected regions of interest on a plate image

Description

Draws the detected dish boundary, colony outline, and any detected crack segments on top of the original plate photograph, using EBImage::readImage() and EBImage's drawing primitives. This lets you visually verify that automated segmentation and crack detection were computed as expected, rather than trusting the summary statistics alone.

Usage

```
plot_grayleafspot_overlay(
  run,
  id = NULL,
  image_path = NULL,
  show_dish = TRUE,
  show_colony = TRUE,
  show_cracks = TRUE,
  dish_col = "yellow",
  colony_col = "red",
  crack_col = "cyan"
)
```

Arguments

run	A `grayleafspot_run` object (see `grayleafspot_analyze()`, `read_grayleafspot_results()`), a plain list of per-image raw result records, or a single record (a list with a `rawAnalysis` element, as produced internally by the analysis engines).
id	Optional character. `id` or `filename` of the image to overlay, matched against the records in `run`. Defaults to the first record.
image_path	Optional character. Explicit path to the source image. Falls back to the record's stored `imageUrl`, which is only a resolvable local file path for runs produced by the pure-R fallback engine; for runs produced by the Python/basilisk pipeline, pass this explicitly (e.g. a file inside the original `input_dir`).
show_dish, show_colony, show_cracks	Logical. Which overlays to draw.
dish_col, colony_col, crack_col	Character. Colors for each overlay, passed to `grDevices::col2rgb()`.

Value

An EBImage::Image with the requested overlays drawn on it. Display with `EBImage::display()` or save with `EBImage::writeImage()`.

Examples

```
image_file <- tempfile(fileext = ".png")
png::writePNG(matrix(seq(0, 1, length.out = 32^2), 32), image_file)
decoder_available <- tryCatch({
  EBImage::readImage(image_file)
  TRUE
}, error = function(e) FALSE)
if (decoder_available) {
  record <- list(
    imageUrl = image_file,
    rawAnalysis = list(
      dish_center = list(x = 500, y = 500),
      dish_radius = 400
    )
  )
  overlay <- plot_grayleafspot_overlay(record)
}
unlink(image_file)
```

plot_growth_roughness *Plot relative growth rate and edge roughness*

Description

Plot relative growth rate and edge roughness

Usage

```
plot_growth_roughness(x)
```

Arguments

x	A grayleafspot_run object or data accepted by as_grayleafspot_growth_data().

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_growth_roughness(run)
```

plot_radial_growth_area *Plot radial growth rate and colony area by plate over time*

Description

Produces a faceted panel with colony area (mm^2) on one facet and radial growth rate (mm/day) on the other. When each plate appears only once in the data, points from all plates are connected in day order.

Usage

```
plot_radial_growth_area(x)
```

Arguments

x	A grayleafspot_run object or data accepted by as_grayleafspot_growth_data().

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_radial_growth_area(run)
```

plot_radial_profile *Plot the radial intensity profile from the first image in a run*

Description

Reads the `radialProfile` field from `raw_results`. When called with a plain data frame, the function auto-discovers the most recent `analysis.json` under `outputs/` in the working directory.

Usage

```
plot_radial_profile(x)
```

Arguments

`x`	A `grayleafspot_run` object, a path to a run directory or `analysis.json`, a list of raw results, or a data frame.

Value

A `ggplot2` object.

Examples

```
run <- example_grayleafspot_results()
plot_radial_profile(run)
```

plot_shape_vs_stress *Scatter plot of colony shape vs crack stress*

Description

Plots eccentricity against crack coverage percentage, with point size proportional to colony diameter and colour encoding time (day).

Usage

```
plot_shape_vs_stress(x)
```

Arguments

`x`	A `grayleafspot_run` object or data accepted by `as_grayleafspot_growth_data()`.

Value

A `ggplot2` object.

Examples

```
run <- example_grayleafspot_results()
plot_shape_vs_stress(run)
```

plot_stress_remodeling

Plot crack coverage and crack count over time

Description

Plot crack coverage and crack count over time

Usage

```
plot_stress_remodeling(x)
```

Arguments

x	A grayleafspot_run object or data accepted by as_grayleafspot_growth_data().

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_stress_remodeling(run)
```

plot_texture_organization

Plot texture entropy and center-to-edge intensity delta over time

Description

Plot texture entropy and center-to-edge intensity delta over time

Usage

```
plot_texture_organization(x)
```

Arguments

x	A grayleafspot_run object or data accepted by as_grayleafspot_growth_data().

Value

A ggplot2 object.

Examples

```
run <- example_grayleafspot_results()
plot_texture_organization(run)
```

read_grayleafspot_results

Read a saved grayleafspot run from disk

Description

Loads a run directory (containing `analysis.json`, `analysis.csv`, and `manifest.json`) or a single JSON / CSV file and returns a `grayleafspot_run` object.

Usage

```
read_grayleafspot_results(path)
```

Arguments

`path`	Character. Path to a run directory or to an individual `analysis.json` / `analysis.csv` file.

Value

A `grayleafspot_run` object with elements `$run`, `$results`, and `$raw_results`.

Examples

```
dir <- system.file("extdata", "example", package = "grayleafspotr")
run <- read_grayleafspot_results(dir)
```

write_grayleafspot_results

Write grayleafspot results to disk

Description

Serialises a list of result records to `analysis.json`, `analysis.csv`, and `manifest.json` under `output_dir` and returns a `grayleafspot_run` object.

Usage

```
write_grayleafspot_results(
  results,
  output_dir,
  engine = "python-local",
  engine_model = "packaged-python-pipeline",
  run_name = NULL
)
```

Arguments

results	A list of per-image result records (as produced by the Python pipeline or analyze_grayleafspot_ima
output_dir	Character. Directory to write outputs into (created if absent).
engine	Character. Engine label stored in the manifest.
engine_model	Character. Engine-model label stored in the manifest.
run_name	Optional character. Human-readable run name for the manifest.

Value

A grayleafspot_run object.

Examples

```
run <- example_grayleafspot_results()
write_grayleafspot_results(run$raw_results, tempdir(), run_name = "demo")
```

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