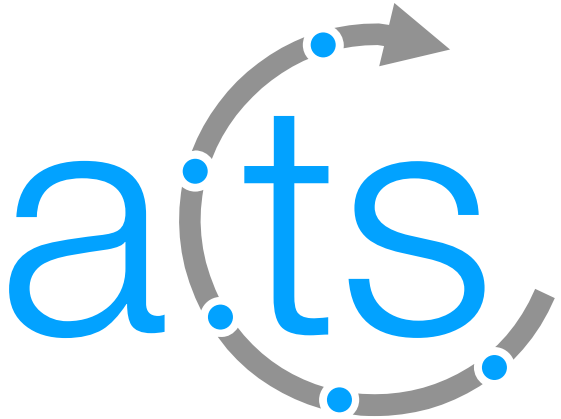
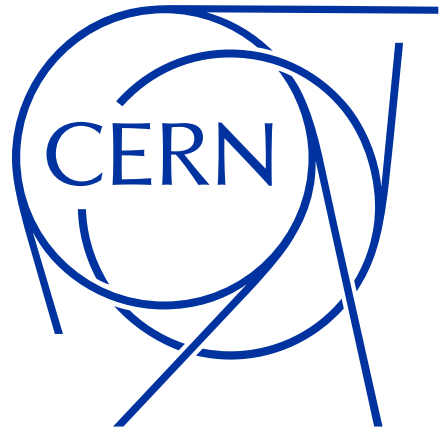




Introducing Acts White Papers

Paul Gessinger-Befurt & Felix Russo

November 8, 2023

Introduction

- A white paper[1] …
  - … informs concisely about a complex issue
  - … helps readers understand a topic, solve a problem, or make a decision

- In Acts, white papers come as LaTeX documents
  - Easy & powerful plotting, e.g., using TikZ
  - Easy cross-referencing
  - Easy citations
  - Write (very) fancy equations

- Each white paper has a GitHub repository that is indexed in the documentation

- Today: Tutorial on how to add your own LaTeX document to the Acts documentation[2]

[1] See here, accessed on November 7, 2023
[2] You can find the Acts documentation on how to add white papers here

Example

- During vertex seed finding, tracks are modelled as 2D probability distributions
  - Vertex seed = Maximum of the distribution
  - Seed width: Calculated from the FWHM of the distribution

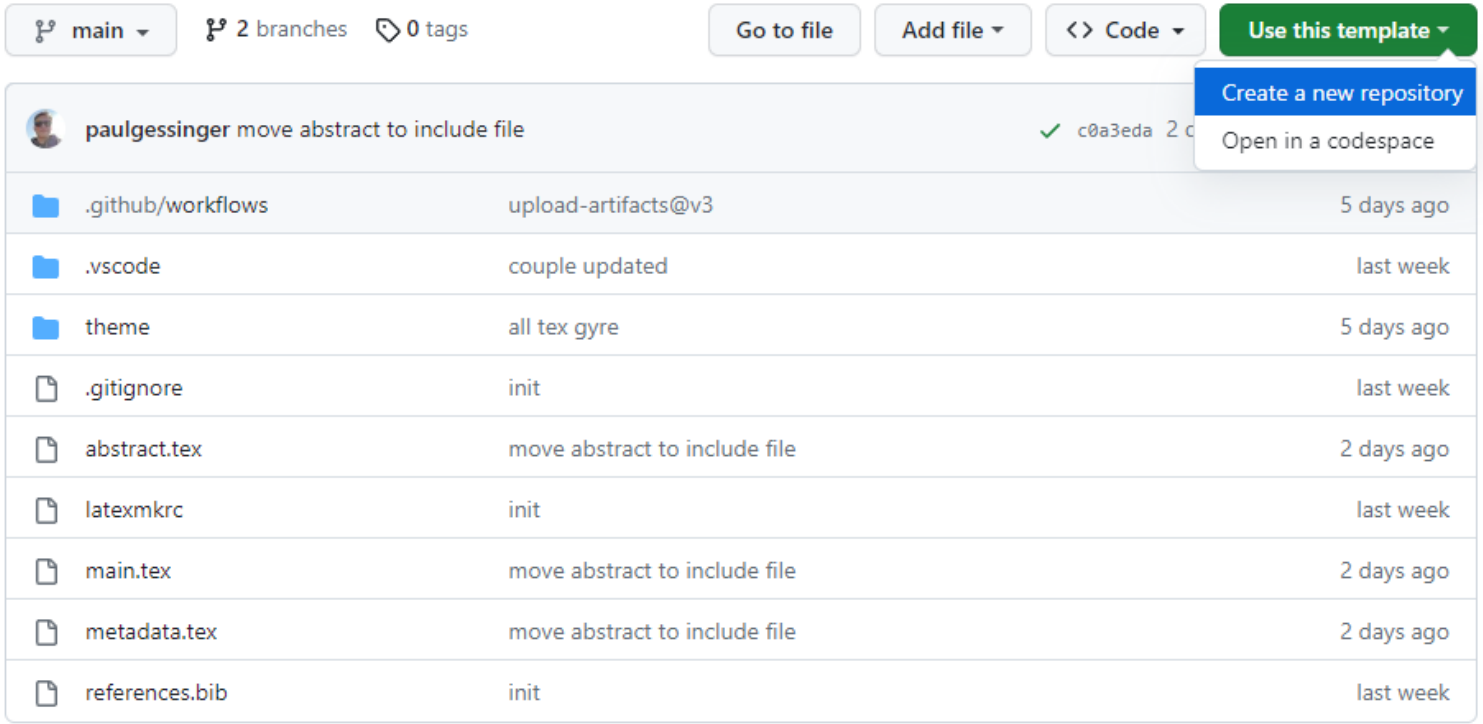
- For a single track, one can compute the maximum and the width analytically
  - Unit test: Compare numerical and analytical calculations

- Without derivation it is hard to see where the analytical expressions come from
  → Make a white paper

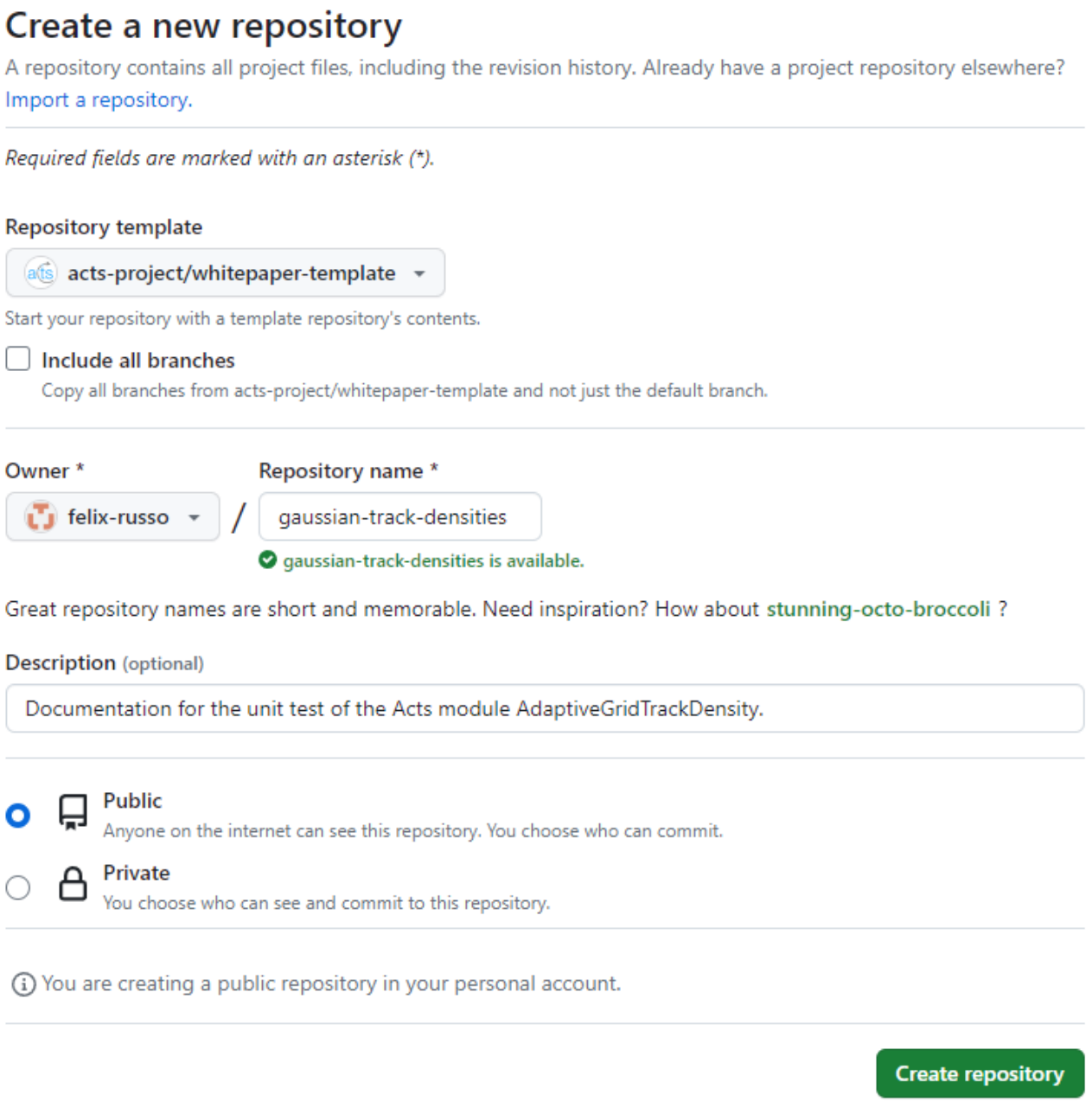
[1] FWHM = Full Width at Half Maximum

Copy Template Repository

- Go to https://github.com/acts-project/whitepaper-template
- Click on “Create a new repository”



- Provide a name and a description
- Click on “Create repository”

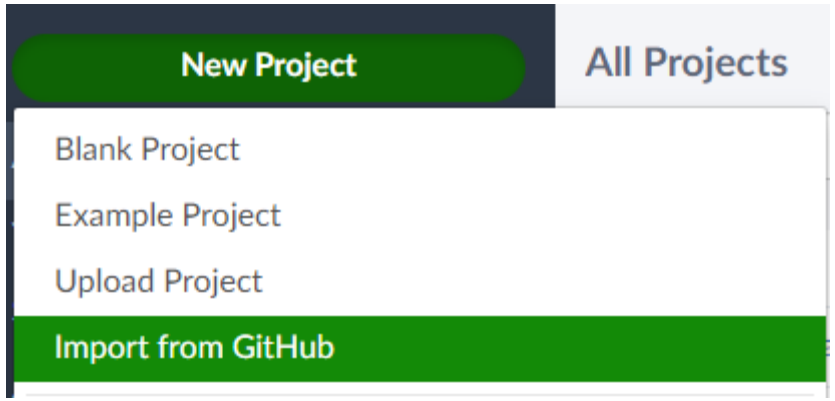


Local Compilation and Usage of Overleaf

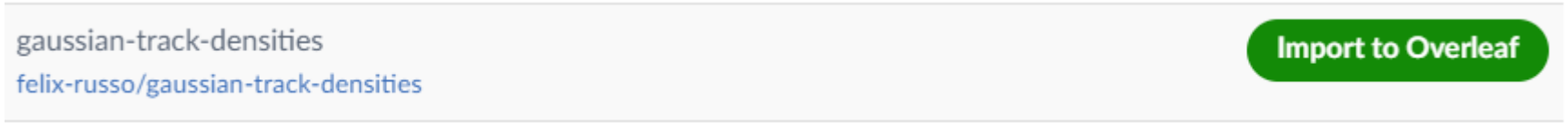
- You can modify the repository either locally or on Overleaf
- Overleaf = Web-Based LaTeX tool with GitHub integration
- In this tutorial, we will focus on Overleaf

Connect GitHub to Overleaf

- Go to Overleaf
- Click on “New project” and “Import from GitHub”

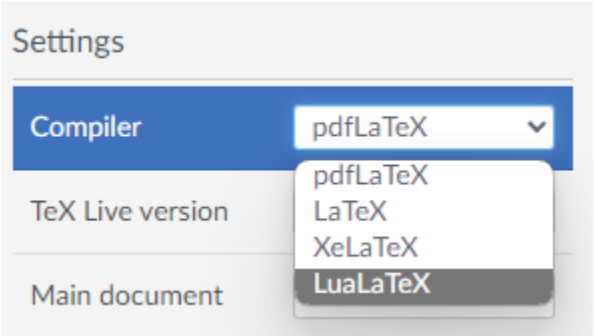


- Import the repository you created in the previous step



Set LaTeX Compiler

- Click on “Menu” and choose LuaLaTeX as your compiler



- Template should compile now

Write a White Paper

- Go to metadata.tex to specify the author(s) and the title

```
\title{Gaussian Track Densities}
\author{Felix Russo}
```

- Write an abstract into abstract.tex
  - You can only use basic LaTeX markup here
  - Gets rendered using MathJax and will be displayed on the website

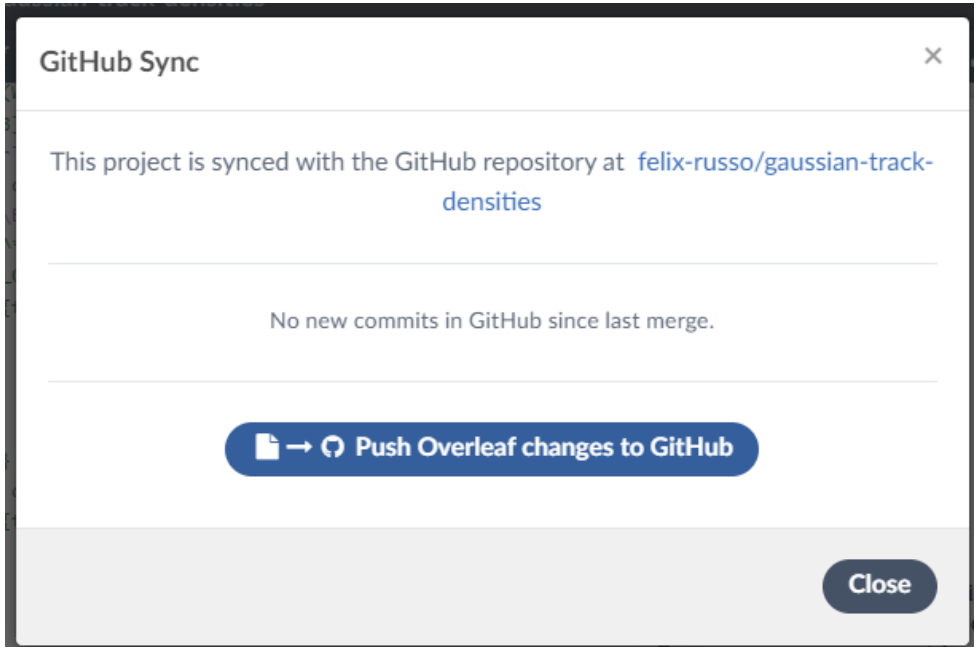
```
%% Only use basic LaTeX markup here, it gets rendered by MathJax.

Given the impact parameters $(d_0, z_0, t_0)$ of a track in Perigee parametrization, one can model the probability of the
particle passing exactly through a point $(d, z, t)$ using a multivariate Gaussian distribution. In this white paper, we
derive the maximum and the width of such a distribution for $d = 0$. This is useful in vertex seed finding, where we only
consider the track density along the beam axis. We use the analytical results from this white paper in the unit test of
the Acts module AdaptiveGridTrackDensity.
```

- Put your references into references.bib
- Recommended: Put your macros into macros.sty

Synchronizing with Github

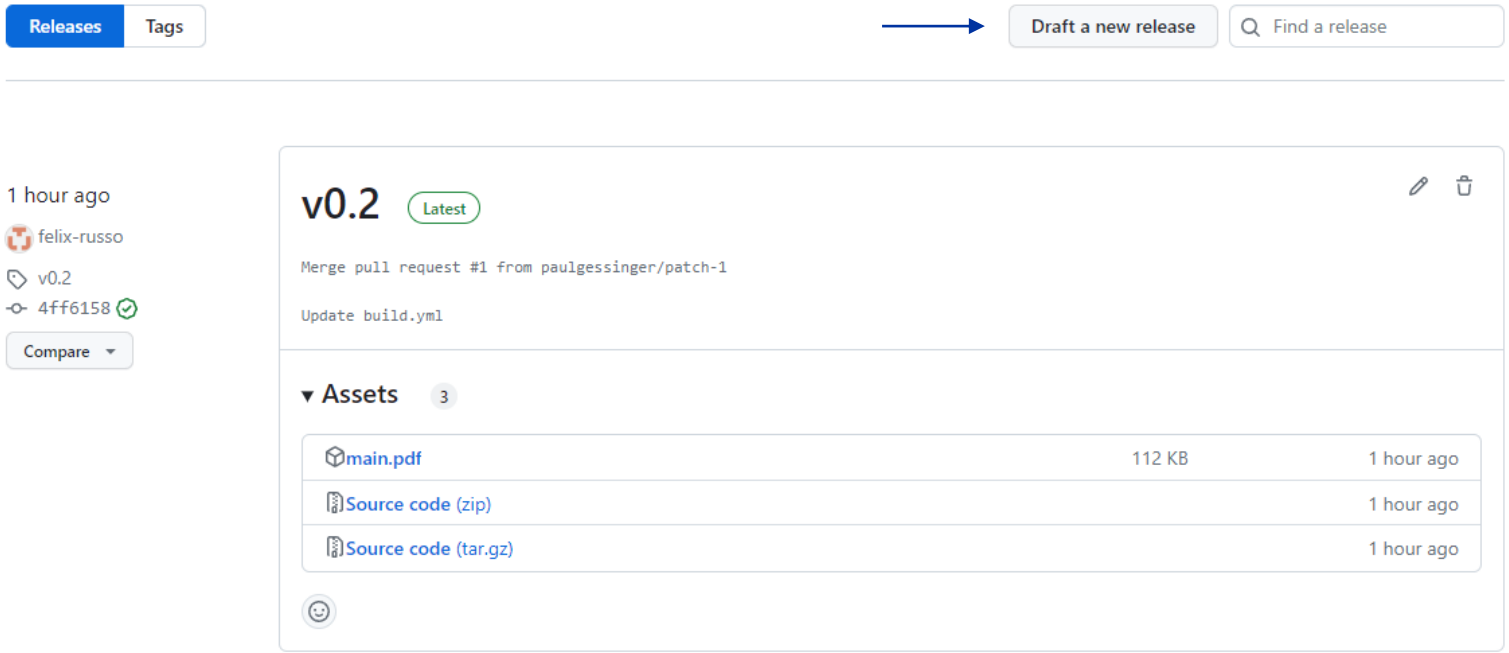
- To push your changes from Overleaf to GitHub
  - Click on the menu
  - Click on GitHub
  - Click on “Push Overleaf Changes to GitHub”

- Tip: Only do changes on Overleaf and push them to GitHub – conflict resolution is tedious in Overleaf



Creating a Tag

- Highly recommended: Version your GitHub repository
  - Latest version is automatically included in the Acts documentation
  - In your GitHub repository, click on “Releases” and then select “Draft a new release”



Installing Requirements

- Create a virtual environment
```
python –m venv venv_white_paper
```
- Activate it
```
source venv_white_paper/bin/activate
```
- Install requirements
```
pip install –r docs/requirements.txt
```
- Install ImageMagick
```
sudo apt install imagemagick
```
- You might need to modify its security policy according to the second answer here

Add Documentation Entry

- Add the following to the bottom of docs/white_papers.toml

```
[[white_papers]]
repository = "https://github.com/felix-russo/gaussian-track-densities"
slug = "gaussian-track-densities"
```

- To get corresponding metadata and save it to docs/white_papers.toml:

```
docs/white_papers.py pull –github-token $GITHUB_TOKEN
```

- Reference your white paper in the code

- Make a PR & transfer the ownership of your repository to acts
  - PR from today's tutorial is here
  - For ownership transfer, please contact Paul Gessinger-Befurt

Result

- A piece of code with a link …

```
// The analytical calculations of the following can be found here:
// https://acts.readthedocs.io/en/latest/white_papers/gaussian-track-densities.html
// Analytical maximum of the Gaussian
ActsSquareMatrix<3> ipWeights = ipCov.inverse();
ActsScalar denom =
    ipWeights(1, 1) * ipWeights(2, 2) - ipWeights(1, 2) * ipWeights(1, 2);

ActsScalar zNom =
    ipWeights(0, 1) * ipWeights(2, 2) - ipWeights(0, 2) * ipWeights(1, 2);
ActsScalar correctMaxZ = zNom / denom * d0 + z0;

ActsScalar tNom =
    ipWeights(0, 2) * ipWeights(1, 1) - ipWeights(0, 1) * ipWeights(1, 2);
ActsScalar correctMaxT = tNom / denom * d0 + t0;

// Analytical FWHM of the Gaussian
ActsScalar correctFWHM = 2. * std::sqrt(2 * std::log(2.) / ipWeights(1, 1));
```

Result

- … to a white paper!

Gaussian Track Densities

GitHub

Authors

- Felix Russo

Description

Given the impact parameters (d_0, z_0, t_0) of a track in Perigee parametrization, one can model the probability of the particle passing exactly through a point (d, z, t) using a multivariate Gaussian distribution. In this white paper, we derive the maximum and the width of such a distribution for $d = 0$. This is useful in vertex seed finding, where we only consider the track density along the beam axis. We use the analytical results from this white paper in the unit test of the Acts module AdaptiveGridTrackDensity.

Questions and Feedback…

- … are more than welcome!