Revamping the calcium image analysis tool NeuralActivityCubic: A collaborative approach to upgrade scientific software

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Using design patterns in your project-specific software makes it easier to maintain, add new features, and share with others!

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Background:

➢ *NeuralActivityCubic* (NA³) is an open-source calcium image analysis tool developed by scientists as secondary output in a publicly funded project [1]

➢ Today, several years later, critical dependency conflicts render NA³ inaccessible to the scientific community and demand it`s maintenance.

➢ We established a collaboration between the original developers of NA³ and professional software developers of the not-for-profit organization Indoc Research to evaluate the impact of applying software development best practices to scientific software, as exemplified by NA³.

Methods:

➢ The original implementation of NA³ was analyzed to determine:

  • Most critical components, and those that will require most flexibility

  • Levels of cohesion and coupling of individual components (Fig. 1)

➢ New implementation leverages design patterns (Fig. 2 and 3), to achieve low coupling and high cohesion, fostering maintainability and extendability.

Results:

➢ Quantitative comparison between the two NA³ versions on NA³´s publicly available test datasets reveals faster computation times of the new implementation, even though it performs additional analyses ➢ ➢

➢ Qualitative evaluation confirmed that the new implementation can easily be extended with new functionalities.

Computation time of NA³ versions
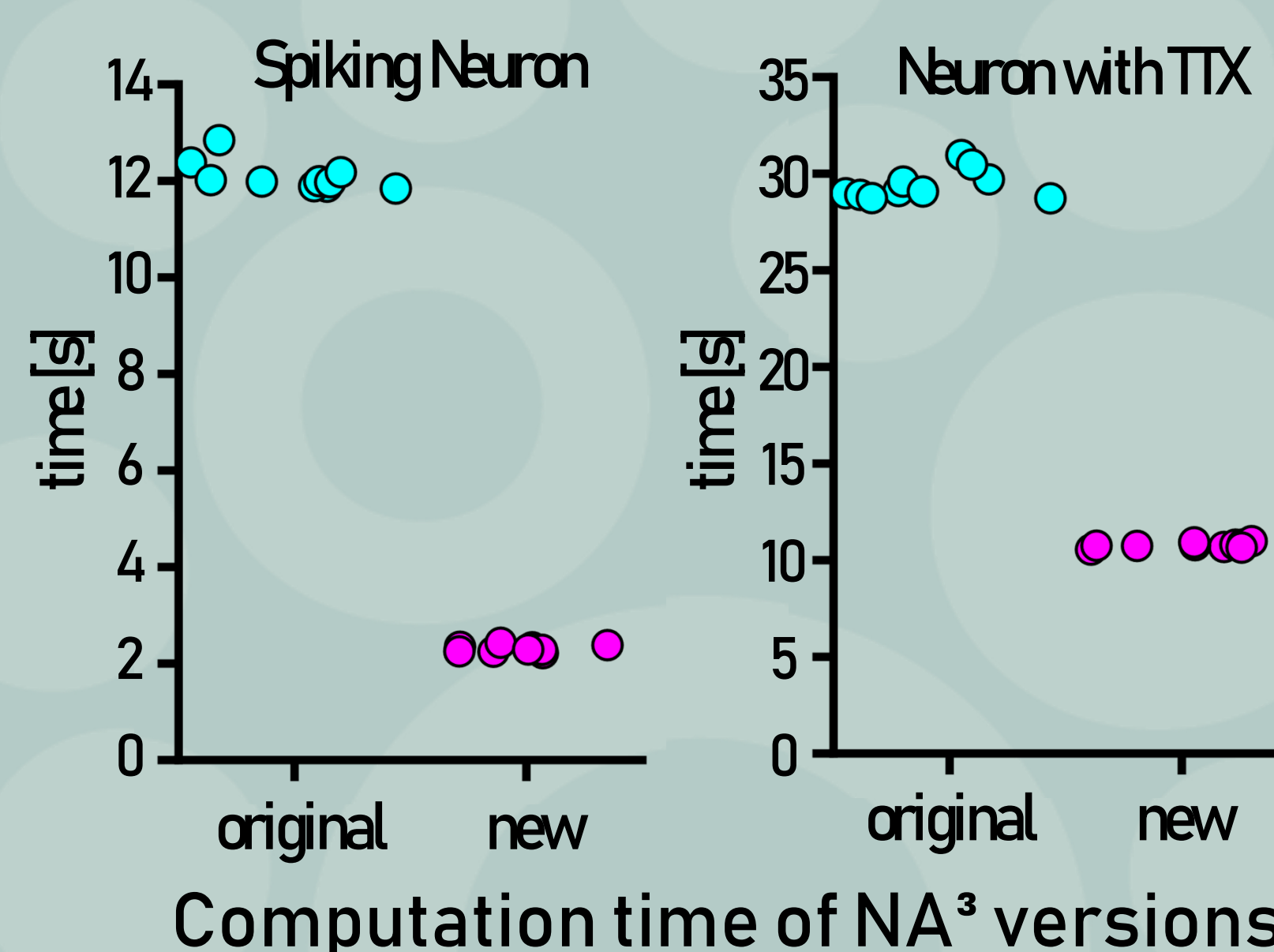
Conclusion:

Our successful collaboration resulted in a high-quality product (Fig. 4) that ensures quick & easy maintenance of NA³ moving forward. This model of collaboration can serve as a blueprint for future scientific software development projects. The new version of NA³ is available via PyPI [2].

References:

[1] Prada J. et al. (2018) An open source tool for automatic spatiotemporal assessment of calcium transients and local 'signal-close-to-noise' activity in calcium imaging data. PLoS Comp. Biol. 14(3)

[2]   NA³ is now available via the python package index (PyPI): www.pypi.org/project/neuralactivitycubic/
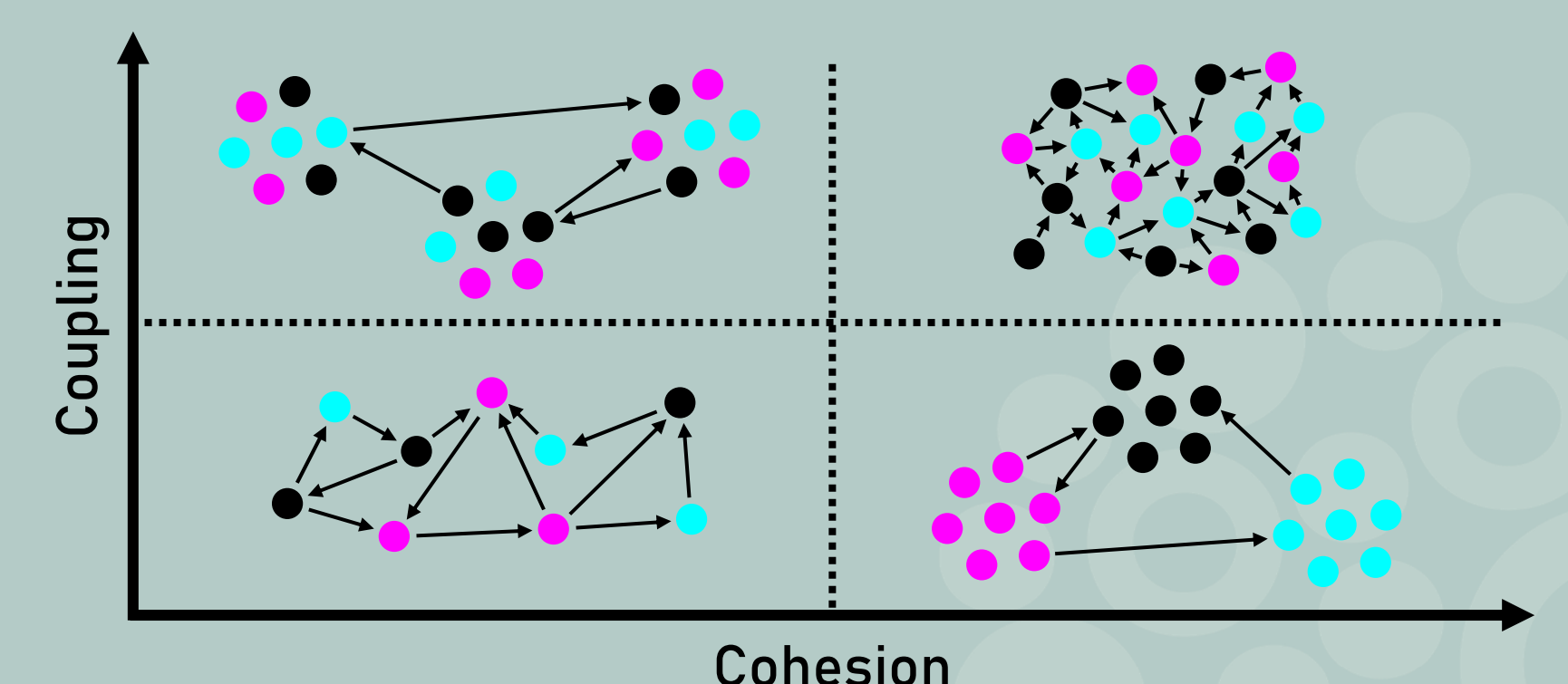
Fig 1: Cohesion vs. Coupling
Cohesion: how closely related are parts of individual components? Coupling: how interdependent are all components? High cohesion and low coupling are ideal.
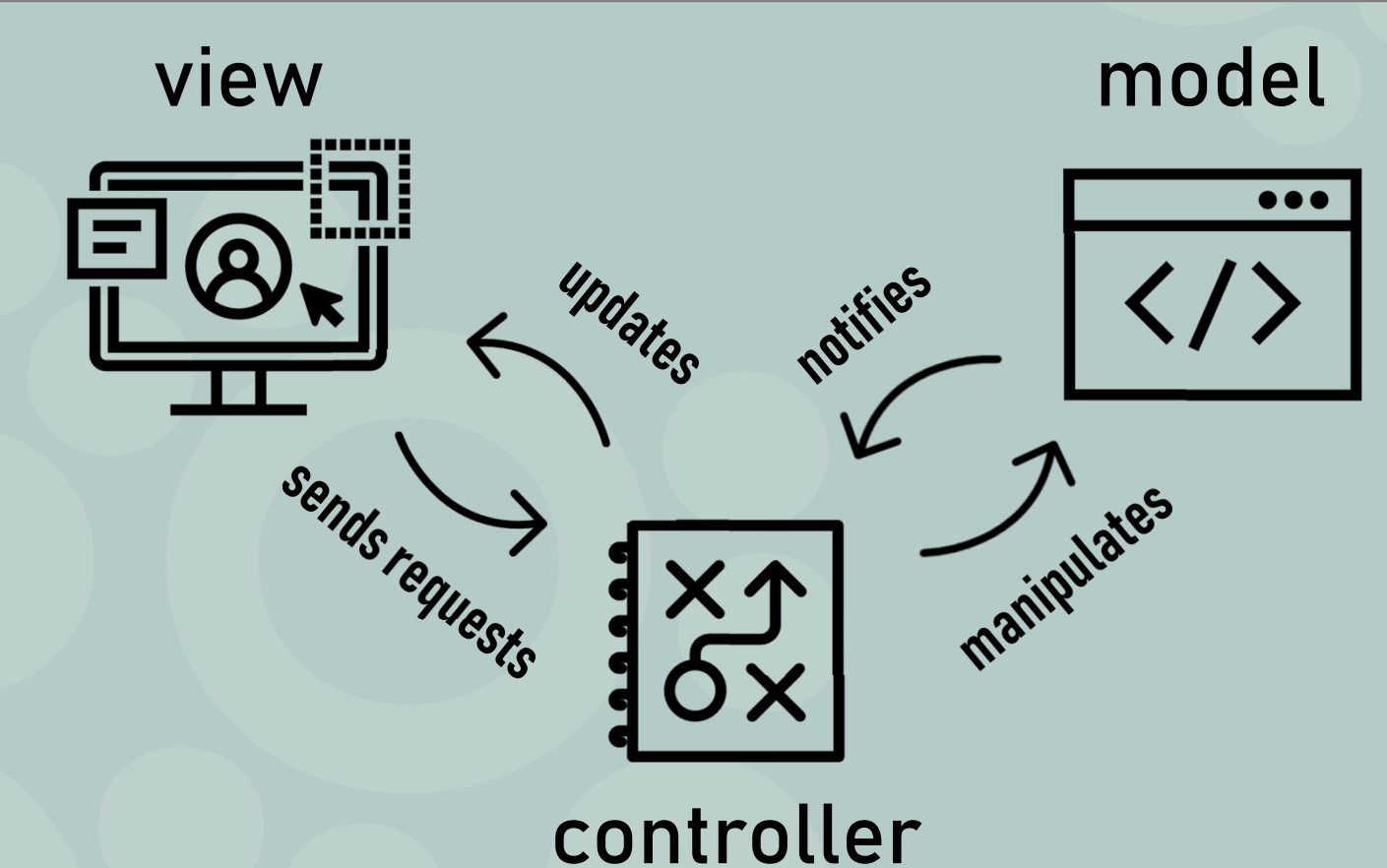

Fig 2: Model-View-Controller pattern
Aims at separating concerns of your application. View: User-interface; Model: the application logic (processing & analysis); Controller: handles user-input and connects Model & View.
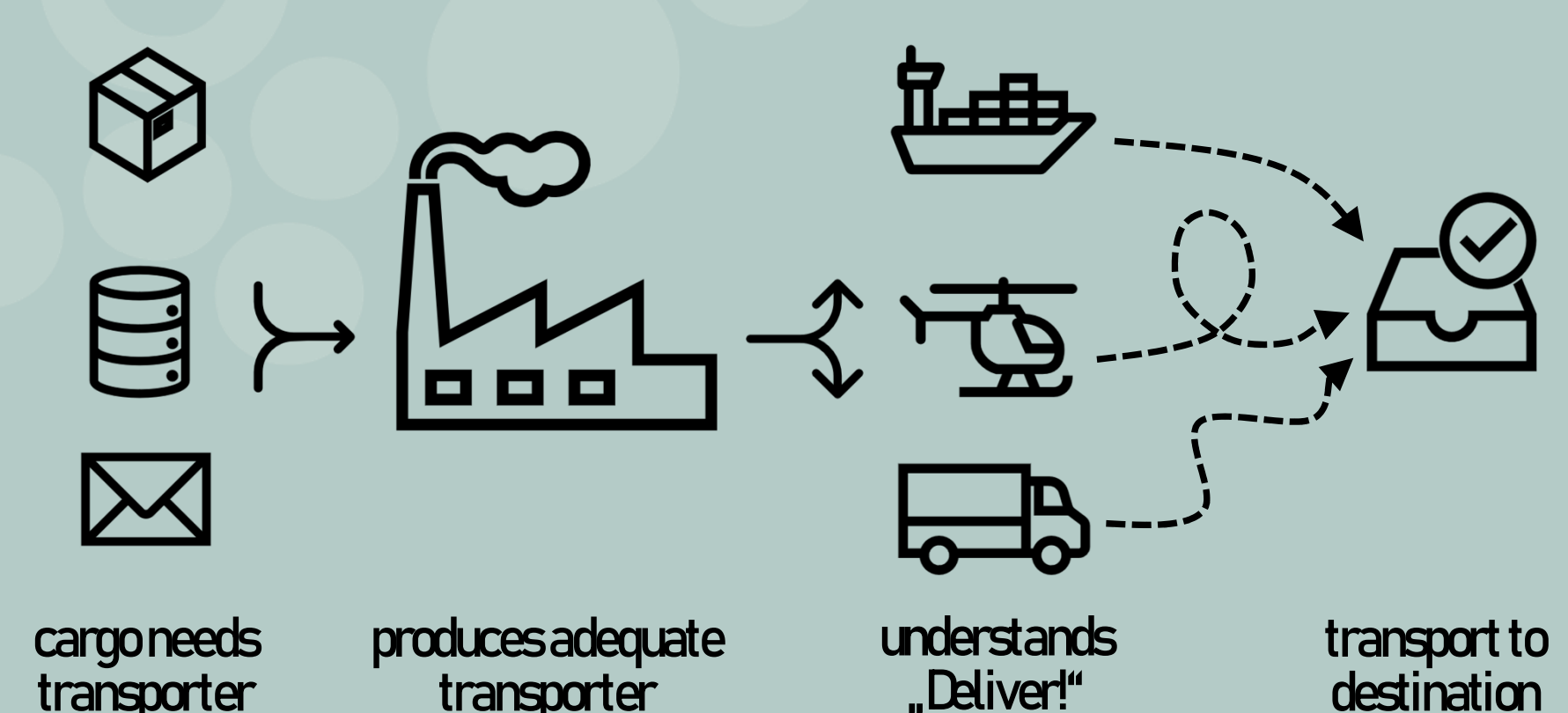

Fig 3: Factory pattern
Analogy: A "transporter factory" produces transporters to deliver cargos. Regardless of the cargo, the factory is always prompted to produce the transporter, which responds to the "Deliver!" command. Thus, by encapsulating object creation, the factory pattern promotes flexibility of your code.
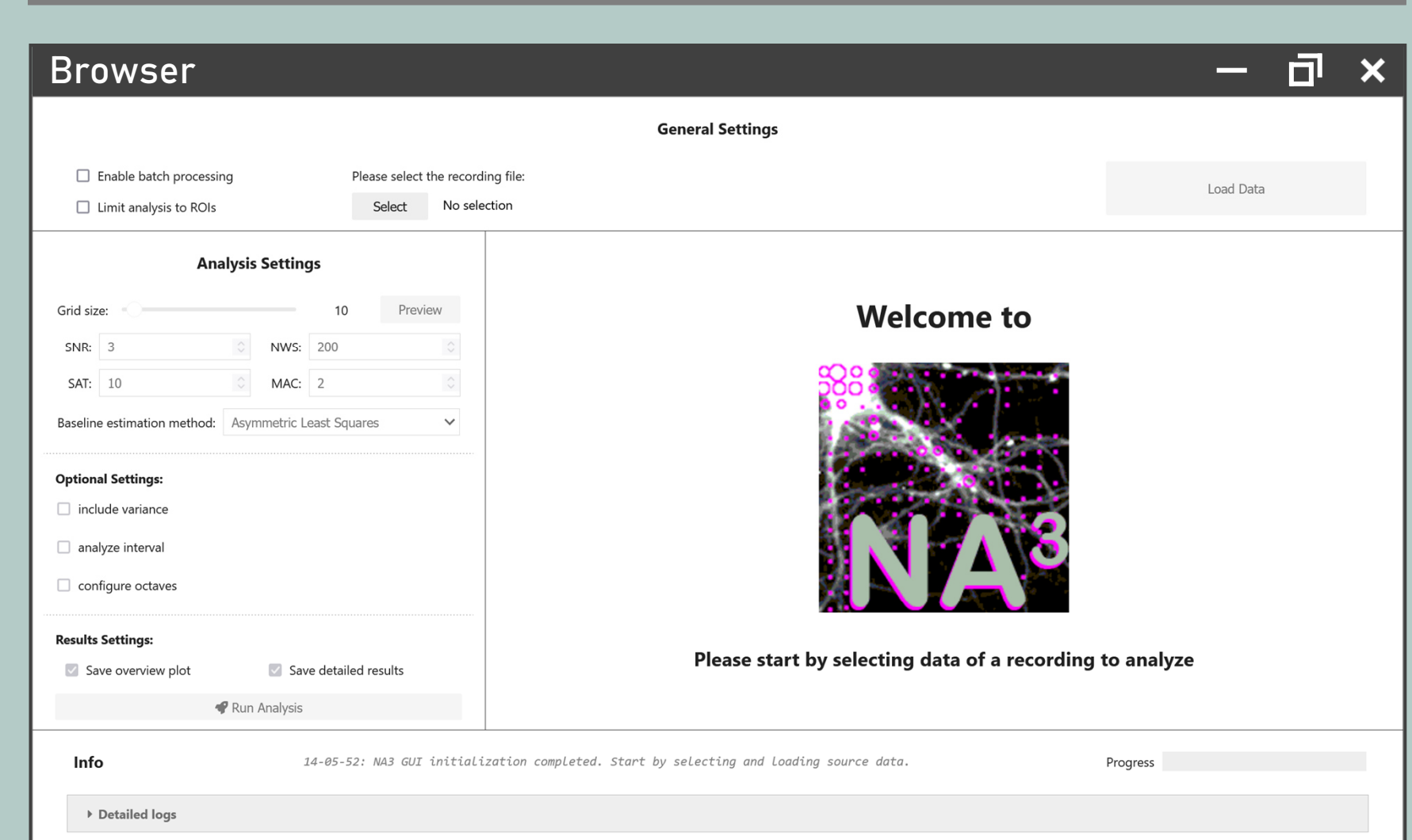

Fig 4: New version of NA³
Implemented in Python with an UI via Jupyter Notebooks.

Contact us for similar collaborations!

The authors declare no conflict on interest.

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See poster P2567 for more infos on NA³!