k-Dispatch: Enabling Cost-Optimized Biomedical Workflow Offloading

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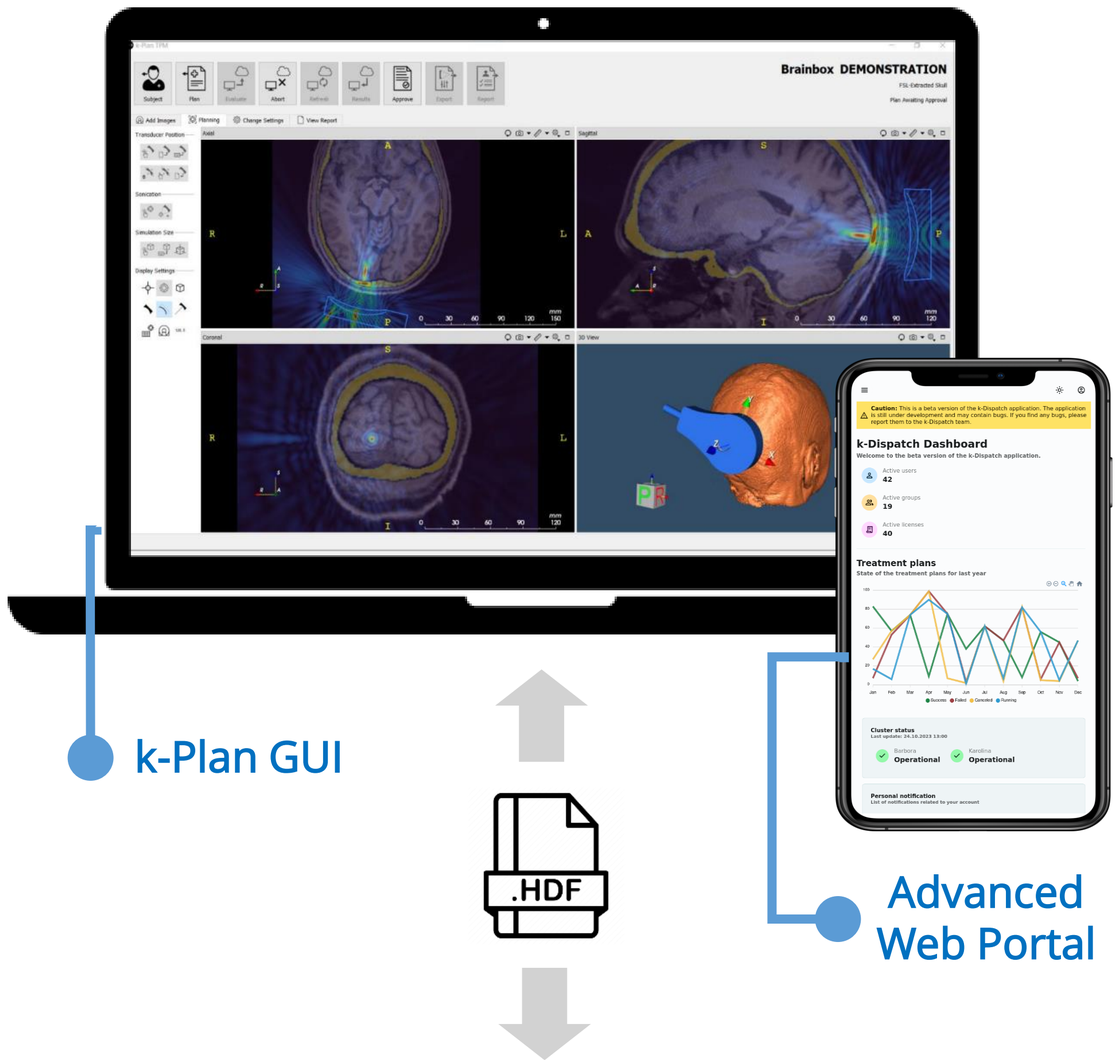
1 k-Plan

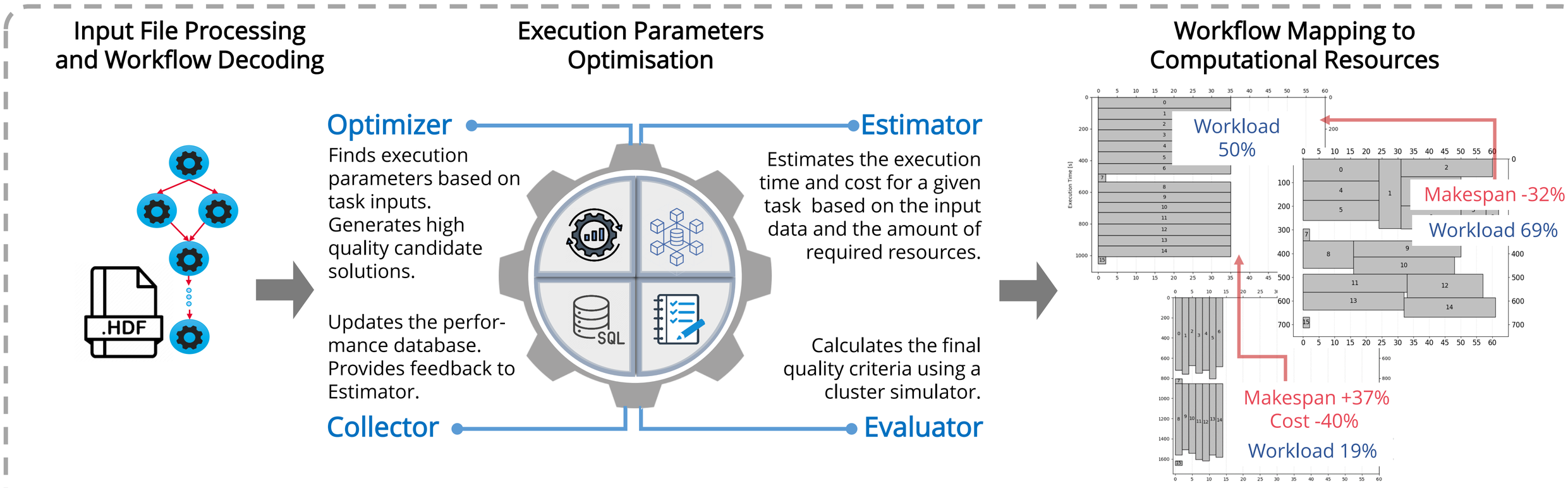
k-Plan, tailored for transcranial ultrasound stimulation (TUS) techniques, serves as a **sophisticated modeling tool for TUS procedure planning**.

With a seamless workflow, k-Plan enables high-resolution calculations for the ultrasound field and temperature within the skull and brain, all effortlessly computed in the cloud or on an HPC cluster with just one click. **No expertise in numerical modeling or high-performance computing is necessary.**



2 Cloud-based Simulations Planning

k-Plan allows access to high-performance computing resources to run high-resolution planning simulations with a single click. Its straightforward installation and intuitive workflow enable users to initiate simulations within minutes, without the need for extra resources or accounts. The automated dispatch server, **k-Dispatch**, **efficiently allocates computing resources** and **minimizes the time between planning and results**. The plan browser automatically updates and displays the status of ongoing simulations.



3 Execution Parameters Optimisation

Optimizer implements a **genetic algorithm** for which **three fitness functions** addressing diverse optimization criteria and computing resources have been designed. **Execution parameters** for workflows counting 64 tasks of different kind and dependencies **can be found within a minute**.

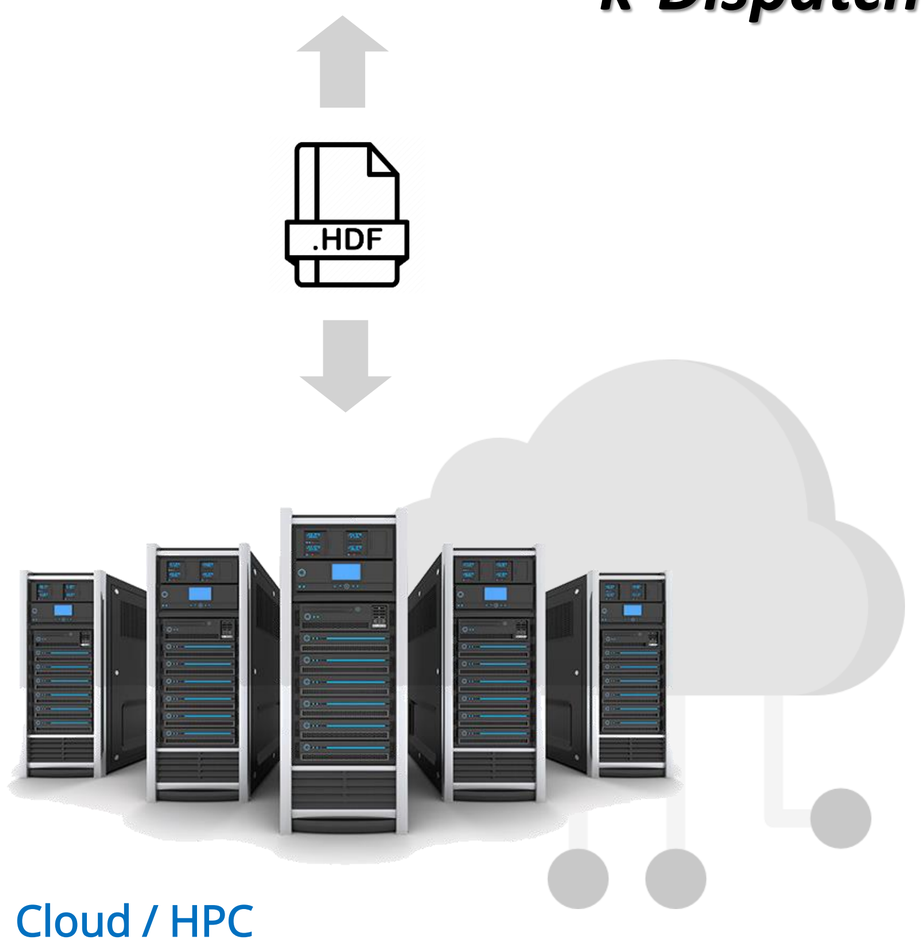
4 Unknown Performance Data

Three different approaches to estimate missing values in the performance have been explored: **(1) linear** and **quadratic interpolations** have shown promising results of **4% and 10% error rate**, respectively, which however, escalated to nearly 25% in testing datasets. **(2)** The **symbolic regression** model demonstrated impressive accuracy achieving an average error of **5.64%. (3)** The trained **artificial neural network** worked well for blind prediction displaying acceptable predictive capability with an error margin of **8.25%**.

5 Conclusions

The presented approach represents a strong foundation for future developments in execution time prediction, with potential applications **beyond ultrasound simulations**. Moving forward, integrating this approach into k-Dispatch **will enable fully automated optimization for ultrasound workflows.**

k-Dispatch



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