

Introduction to FiniteFlow

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Finite Field

➤ Ideas

- Modular arithmetic
- Multivariate interpolating
- Rational reconstruct

A. Von Manteuffel and R. M. Schabinger 1406.4513v2

Widely used in current frontier problems!!

➤ Advantages

- Overcome intermediate expression swell
- Parallelization

three-jet

Abreu, Dixon, Herrmann, Page and Zeng, JHEP(2019)

Abreu, Dormans, Cordero, Ita, Page and Sotnikov, JHEP(2019)

Badger, Hansen, Hartanto and Peraro, PRL(2019)

Laurentis and Maitre. JHEP(2021)

Abreu, Cordero, Ita, Page and Sotnikov, 2102.13609

$u \bar{d} \rightarrow W^+ b \bar{b}$ Badger, Hartanto and Zoia 2102.02516

$q \bar{q} \rightarrow Q \bar{Q}$ Caola, Chakraborty, Gambuti, Manteuffel, Tancredi 2108.00055

FiniteFlow has been applied to a number of cutting-edge scientific calculations

FiniteFlow

➤ Website

- <https://github.com/peraro/finiteflow>
- <https://github.com/peraro/finiteflow-mathtools>

➤ Reference

- Tiziano Peraro, *FiniteFlow: multivariate functional reconstruction using finite fields and dataflow graphs* 1905.08019

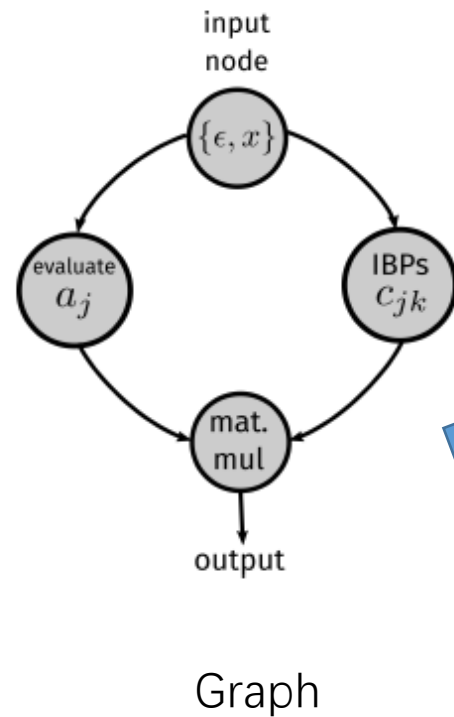
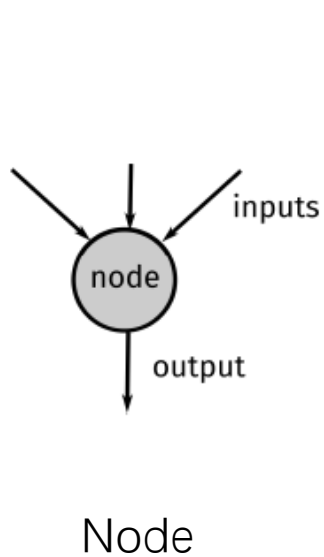
FiniteFlow

➤ Components

- Dataflow graph
 - graph
 - node
- Numerical algorithms
 - solving linear systems
 - evaluating rational functions
 - laurent expansion
 - ...
- Functional reconstruction algorithm

Dataflow graph

➤ Reduction of scattering amplitudes



$$A = \sum_j a_j I_j$$
$$I_j = \sum_{k \in MIs} c_{jk} G_k$$

↓

$$A = \sum_{k \in MIs} A_k G_k$$
$$A_k = \sum_j a_j c_{jk}$$

A blue arrow points from the right-hand side of the equations towards the "mat. mul" node in the dataflow graph diagram.

Example

- Useful wrappers
- Basic usage
- Application: Integral reduction
- Application: Differential equation