

PEigFEx – Orthogonal Layers of Parallelism in Large-Scale Eigenvalue Computations

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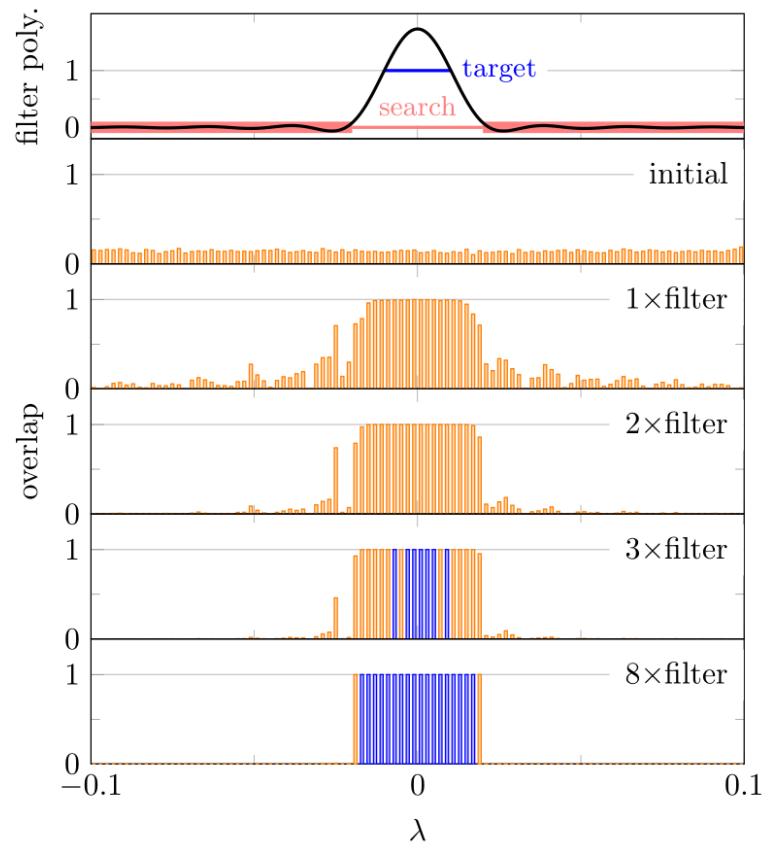
HPC Café, NHR@FAU

February 14, 2023

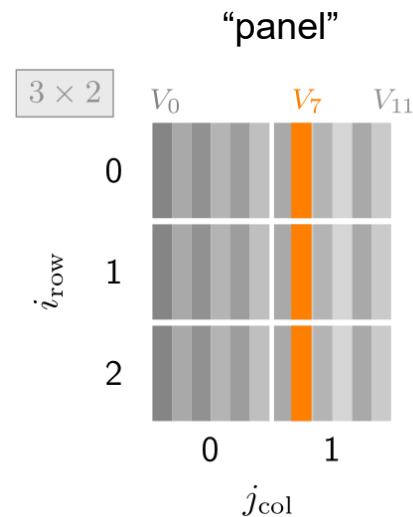
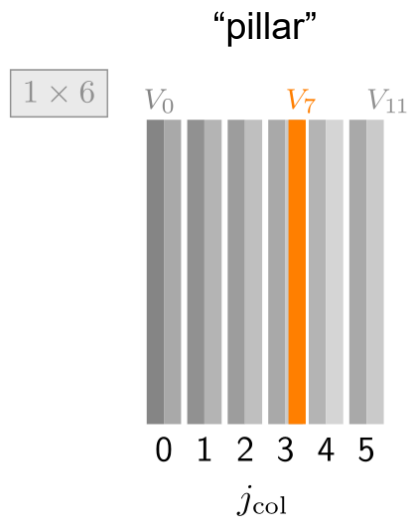
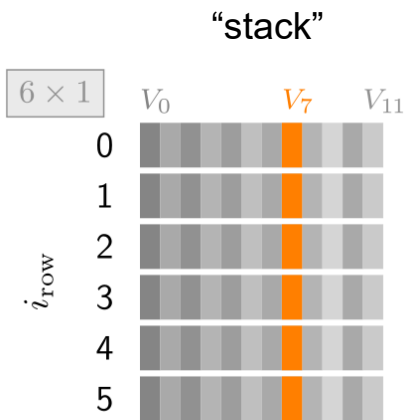


Problem statement

- Goal: Obtain (non-boundary) part of the spectrum of a large sparse matrix around a target eigenvalue
- Construct filter polynomial to map search vectors $v \mapsto p[\hat{A}]v$
- Central operation: sparse matrix-multiple-vector multiplication (SpMMV)
- Question: How to distribute the work in a hybrid-parallel setting?



Alternatives for the vector distribution



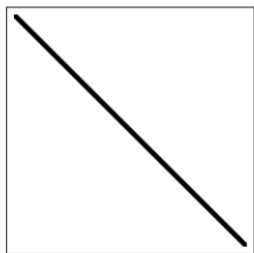
Matrix
distribution

Row
chunks

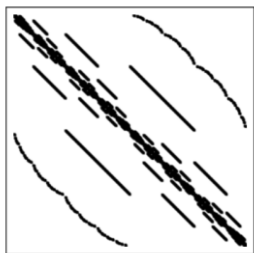
Matrix
duplicated
(# vectors)

Matrix
duplicated
(# columns),
row chunks

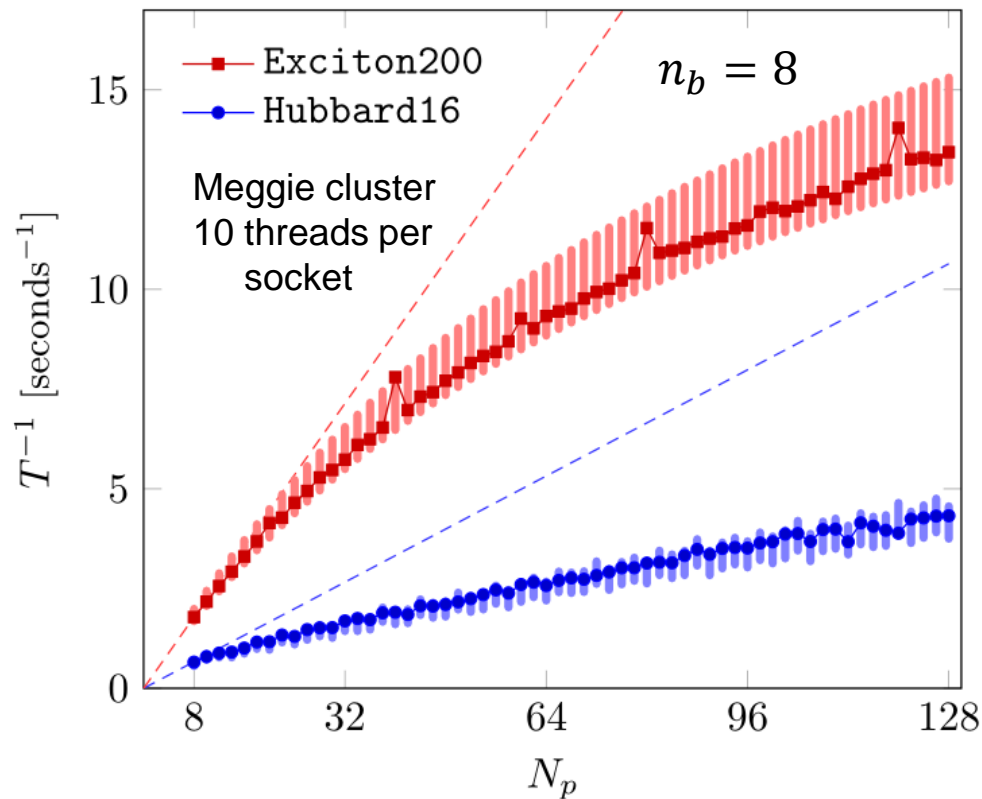
Performance scaling of stack layout



Exciton



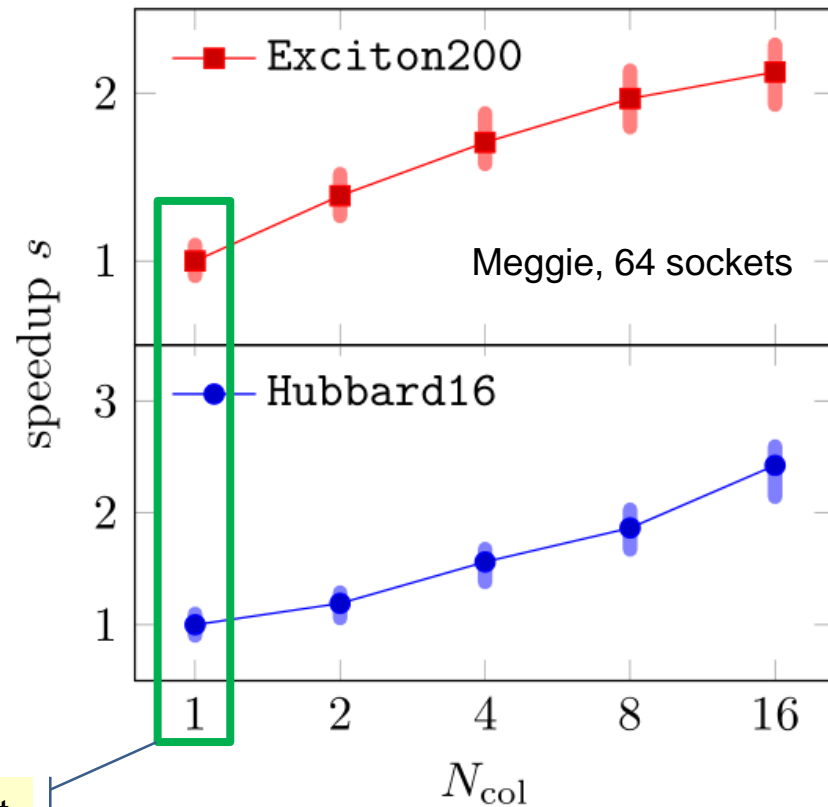
Hubbard



Speedup of the panel layout

- Pillar layout → no communication in SpMMV
- Matrix duplication limits # of columns
 - Unless SpMMV can be done matrix free

Alvermann, Hager, Fehske,
<https://arxiv.org/abs/2209.01974>



Stack layout