



Exploring Optimization opportunities on TRACCC clusterization algorithm

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Team



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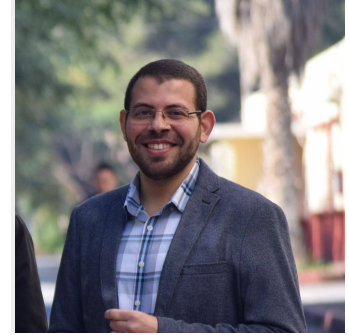
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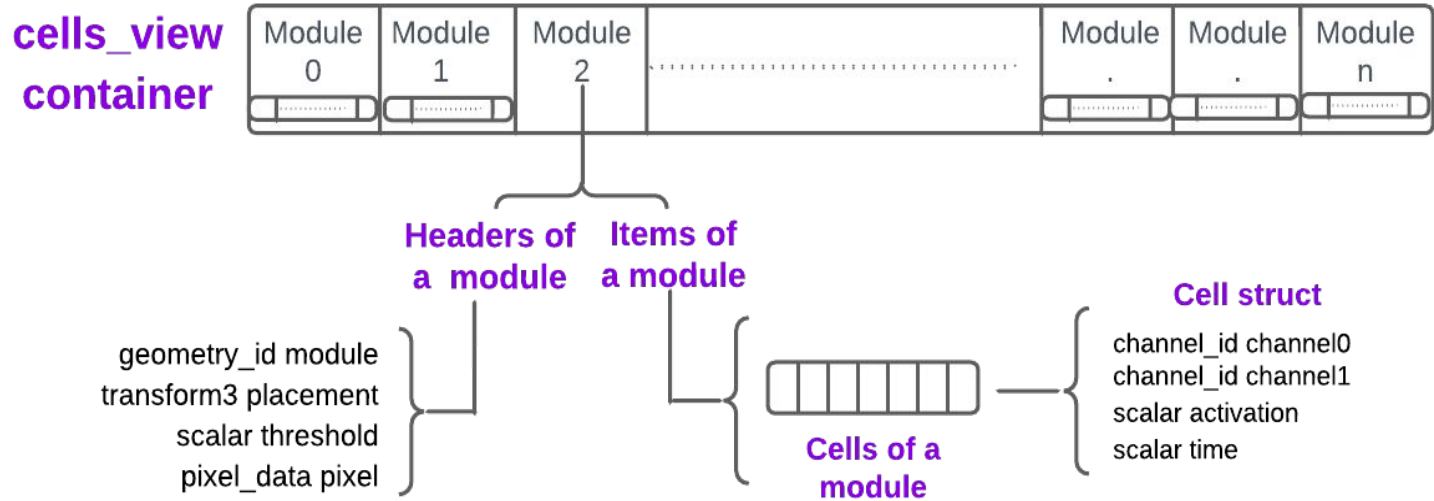


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TRACCC Data Structures

- Vecmem containers are composed of Vectors of Vectors of Structures
- The first access seems to be coalesced but the second is random



Problems: Uncoalesced access

- **Non-coalesced access**

The data is accessed in a non-contiguous pattern (memory locations), which can lead to memory traffic

Array of struct (AOS)

```
struct cell {  
    channel_id channel0 = 0;  
    channel_id channel1 = 0;  
    scalar activation = 0.;  
    scalar time = 0.;  
};  
  
cell_container_types = container_types<cell_module, cell>;  
  
struct cell_module {  
    geometry_id module = 0;  
    transform3 placement = transform3{};  
    scalar threshold = 0;  
    pixel_data pixel;  
};
```



strided memory access
(slow)

GPU friendly memory access

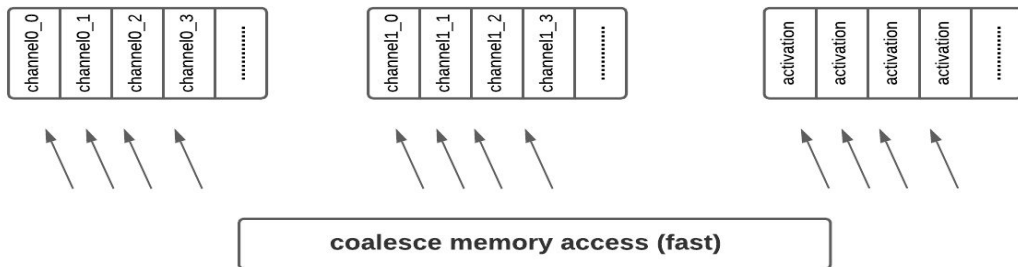
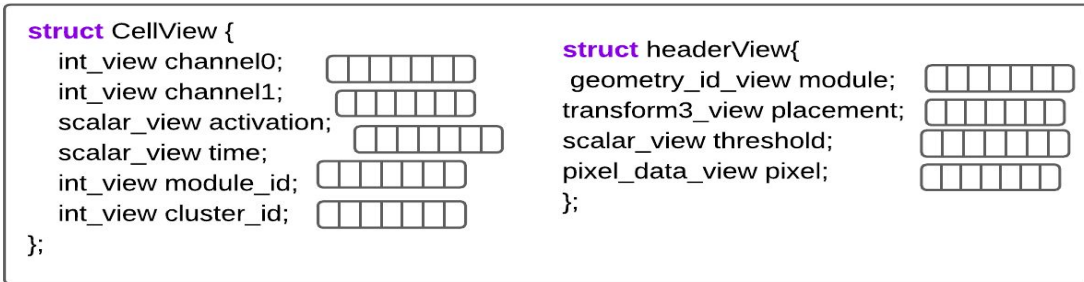
- **Struct of Array (SOA) instead of Array of Struct(AOS):**

- -each array contain a single element of data

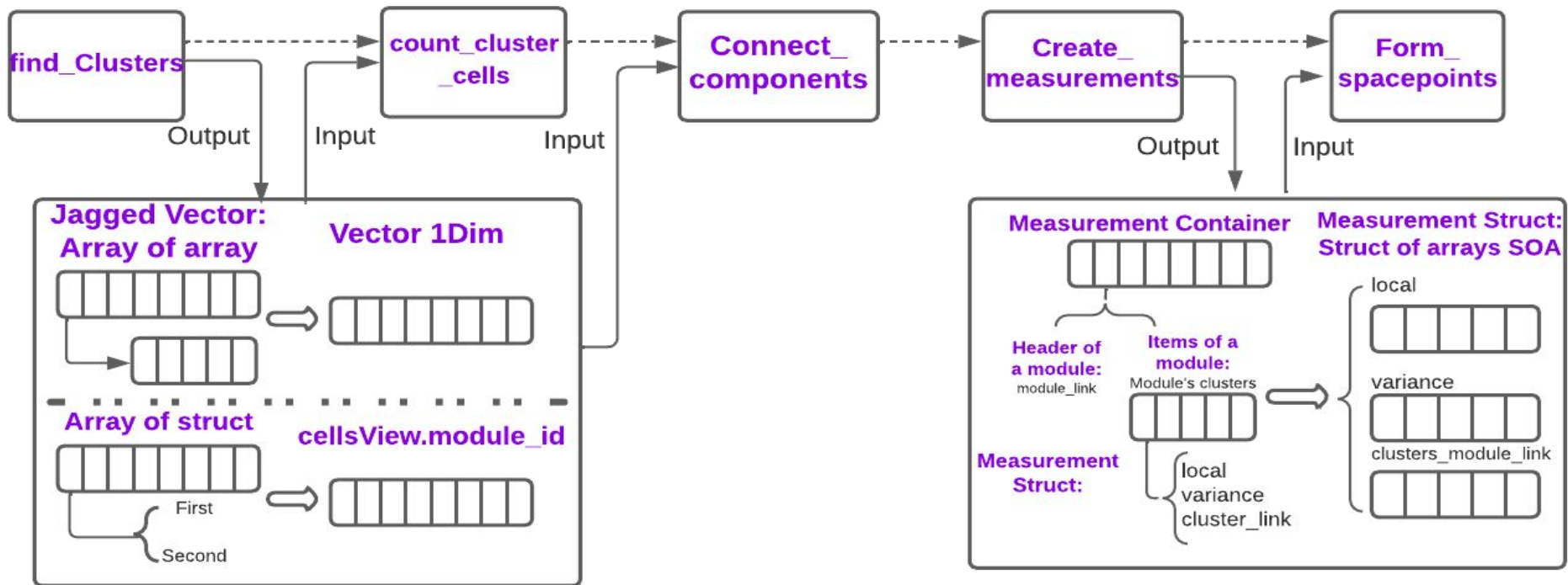
- combining multiple memory accesses Into a single transaction

- Data can be divided by Cell, Cluster or Module simply

struct of array (SOA)



Workflow



Evaluation

- Tests on My laptop's entry level GPU GTX 1050
- Cells reading from file is better because of the use of Hash tables instead of vectors
- Some Kernels are 40% better just by modifying the data Structure

Summary

- Data arrangement in GPU can be critical to get the best performance
- Algorithms are not changed only data arrangement is changed
- This method is applicable on all parts of TRACCC where containers are used
- Should we continue exploring Old Clusterization method?