

Experience porting Shower Reco from Larlite to Larsoft

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Larsoft Meeting 1/19/16

Motivation

- Most of the developments in EM shower reconstruction have happened in larlite over the past 6 months.
- In order for everyone to be able to use these improvements, I have been porting code to larsoft.
 - This affects larreco, mostly, but also lardata.

Areas in Larsoft that Are affected

- Larreco/RecoAlg/ClusterRecoUtil
 - We completely rewrote ClusterParams Alg to make it faster and easier to maintain, improvements were presented at a microboone reco lunch (See [Uboone 4800](#) for example.)
- Larreco/RecoAlg/CMTool
 - Depends on ClusterRecoUtil, used to pass around instances of ClusterParamsAlg to various modules for processing, now passes cluster::cluster_params
 - Used for merging and matching of clusters in larlite. Not used directly for shower reco, but updating ClusterRecoUtil required updating CMTool to prevent build issues.
- Larreco/ShowerFinder
 - Will be adding a subdirectory for shower reco algorithms, and small tweaks are required to accommodate the changes made in ClusterRecoUtil.
- Lardata/Utilities
 - Added a class GeometryHelper which replaces GeometryUtilities

ClusterRecoUtil

- ClusterParams.h has been merged between larsoft and larlite
 - Contains extra cluster parameters like principal axis, start and end point, start direction, ... [ClusterParams.h](#)
 - Larsoft added some new parameters that are used in cluster finding, larlite has now added those too
 - Larlite added several parameters for shower reco
- Fully merged file is already pushed to larlite, and is on branch `cadams_showerRecoMerge` in larlite.

ClusterRecoUtil 2

- A new suite of algorithms for computing cluster params is added to larsoft.
 - Due to namespace issues, it's in the namespace “larlite” and in file “ClusterParamsAlgLarlite”
 - This is to prevent any issue or conflict with current cluster producing algorithms. I think the plan is to resolve these after the merge of shower reco is finished.
- ClusterRecoUtil/Alg was added and contains the algorithms to fill cluster_params.
- Also includes debugging features to show you how each algorithm changes cluster_params while filling.

CMTool

- Cluster Merging and Matching is done in CMTool, which has a lot of functions that look like:

```
virtual bool Bool(  
const ::cluster::ClusterParamsAlg &cluster1,  
const ::cluster::ClusterParamsAlg &cluster2);
```

- I've adapted the whole package to accept cluster_params as input instead.

ClusterMergeHelper, etc.

- There are some modules that convert larsoft products into framework independent products that both larlite and larsoft can use interchangeably, such as ClusterMergeHelper.
- The change to CMTool and ClusterRecoUtil means I also have to change those
- **This is where I am right now.**

Shower Reconstruction

- Shower Reconstruction takes in clusters from larsoft, runs them through ClusterParamsAlg, and feeds them into a ShowerRecoAlg.
 - Overview of the process is [Uboone 5052](#)
- Apart from the framework changes caused by updating ClusterRecoUtil, all I have to do is import our new algorithm
 - The new algorithm is actually about half a dozen small, tailored algorithms that are easily maintainable and replaceable.
- I also need to update fcl files accordingly to make this an option to run.