LArSoft Collaboration Phase II

Draft V0.4

LArSoft Steering Sub-Group August 2015

Today the LArSoft core project provides a common infrastructure for contributing and sharing of physics codes for Liquid Argon TPC experiments. The project provides build and release of core executables based on the art framework, and support for each experiment to build and release their own executables. The project also coordinates work with the art team with experiment framework teams e.g. LArLite, and efforts for user support, classes and workshops e.g. Aug 2015 art/LArSoft Class, the continuous integration framework for regression and release testing, etc.

The LarSoft steering group is an experiment spokesperson-led initiative to drive, define and own LArSoft activities. The group is a collaboration within the context of the experiments, university physics and computing groups, the Fermilab Neutrino Platform and supporting computing organizations. The steering group tasked a sub-group of representatives to bring to the table specific recommendations for Phase II of the collaboration. This note is the result of the sub-group meeting in person at the end of July.

The current LArSoft eco-system is basic compared to the capabilities, functionality and scales needed to support LArTPC based collaborative science over the next decade. Automated reconstruction and analysis of large and complex liquid argon based detectors is a previously unmet challenge. The ensemble of algorithms, frameworks, platforms, and applications will need to be usable across diverse computing resources, diverse detectors, and by a dynamically changing pool of analysis developers and operators.

Moving forward the LArSoft software faces changes in technologies, scale of use and must be open to new scientific hypotheses and innovative approaches that the scientists come up with.

To start to address these challenges the LArSoft Steering Sub-Group identified a first set of areas of work – spanning short and longer term - that would benefit from a collaborative approach across the experiments who are part of the Collaboration.

The sub-group proposes organization of two short term activities:

* Requirements Workshop – September 2015. One day workshop to record in a common place the requirements for capabilities, performance, and solutions based on LArSoft Software – categorized by near term (<1 year), medium term (<3years) and long term (<5years). As an example, a new requirement for the program might be capabilities to apply multiple algorithms for any output result including at the granularity of a single event.
* External review of the LArSoft code and infrastructure – Q1 2016. Review by external experts of the capabilities, design, performance, and solutions of the current version of the LArSoft framework and algorithm software.

The sub-group further proposes the following areas to be acted upon over the next year or two:

1. Improving the throughput/effectiveness of production

Note that this is focused more to the code being designed to use distributed resources most rather than on grid resource tools themselves.

* Address current issue of “don’t have my analysis done because my grid jobs are only 1/3 way through. “
* Top down understanding of needs from distributed computing infrastructure for LArSoft based reconstruction and analysis
* Think of how best to handle the distributed data (delivery, access, management) for these applications.
1. Significant improvement in the effectiveness of the current automated algorithms and solutions
* High priority short-term focus on improving the MicroBooNE and LArIAT reconstruction efficiencies and plans towards detector based results in 2016.
* Define the process and metrics, and provide the infrastructure to evaluate different algorithms and approaches for different types of events and analysis.
* Define scope/intend of “automated reconstruction” concept which can mean different things in different situations. Include definition of the role of manual, visual event scanning in the development of algorithms, in the identification of at least a small number of events as well as in the analysis of certain physics processes.
* Continue to revisit the architecture and design of the software to ensure the right separation of functionality and interfaces between components of experiment-specific modules and detector-agnostic algorithms.
* Improve the methodology of code design and development to ensure common code does in fact cover the unique features of individual experiments,.
1. Make development and utilization of visualization tools and components a mainstream component of the program

Note that it is an open question that needs to be determined as to whether general components can be built that are useful for multiple detectors or the area is too detector dependent.

Define the functionality that would benefit reconstruction development and the analysis of LArTPC data and build such a tool.

* Current implementation in LArSoft is primitive.
* Big benefit to the physics output if can work collaboratively on some common themes, components, extensions
1. Organize formal reviews by external experts
* Initial review would be a review of the existing LArSoft architecture, design and code.
* Future reviews would be of planned new developments and roadmaps, cognizant of needs of the different experiments.
* Include experts from other similar collaborations, computer science and industry; including trying out the codes.
1. Increased access to and availability of training and workshops
* Get feedback from next weeks full art/LarSoft Class
* Increased use of LArSoft Forum
* Would roadshow or online class work?
1. Information Feedback and Experts Discussions
* Sponsor information mini-workshops for ongoing experiment feedback and discussion with each other and with experts
1. Low level signal processing
* Computational challenge at 40 Kton detector to go effectively from TPC output to hits
* Find and benefit from available digital signal processing expertise in the general community.
1. Potential for using algorithms in real time/DAQ systems