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Publication Date

2010-06-02

DNA Production Sequencing at the Joint Genome Institute: A Multi-Process Operating System

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The U.S. Department of Energy (DOE) Joint Genome Institute's (JGI) Production Sequencing group is committed to the generation of high-quality genomic DNA sequence to support the mission areas of renewable energy generation, global carbon management, and environmental characterization and clean-up.

In 1999, the Joint Genome Institute opened its doors to the world of production sequencing with its participation in the Human Genome Project. This project set in motion a major change in how DNA sequencing was performed. A mostly manual process was turned into a fully automated production line at the JGI, allowing for an unprecedented amount of DNA sequence to be provided to the scientific community at large. The advances made in technology during and after the Human Genome Project, and the continuous process improvements made to our workflow design, helped to push forward the ability to obtain the equivalent of the human genome (3 billion bases) in only one month time. From 1999 until 2009, the JGI performed this work largely through a process known as Sanger sequencing using capillary sequence technology. Today we run Sanger sequencing at a greatly reduced capacity, along with two new platforms which utilize pyro-sequencing and sequencing by synthesis technologies. The Roche Titanium Genome Sequencer and Illumina Genome Analyzer pipelines have allowed us to increase our sequencing capacity to new levels, 1 trillion bases in a month! What took us 1 month to sequence using capillary technology can now be accomplished in one week. With these continuous advances and changes in our production pipeline, come new challenges. Our production group is now focused on how to schedule and operate a 3 platform multi-process operating system, on a daily basis, while maintaining the safety of our staff and the quality of our sequence data. Presented here will be the Sanger, Roche, and Illumina pipelines and our current strategies for scheduling and operation, along with current optimization projects underway. This work is a joint effort among the Process Optimization, Sequencing Technologies, Instrumentation & Industrial Engineering, and the core Sanger, Roche and Illumina Production group.

The work conducted by the U.S. Department of Energy Joint Genome Institute is supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231

LLNL-ABS-427517