LSC Six-Month Progress Report

Organization Pennsylvania State University Relativity Group (PSURG)

Report Date August 15, 2002

Attachment A

LIGO I Data Analysis

a) Tools for studying the stationarity of LIGO data

> Zaleski (undergraduate), supervised by Finn, will work toward the development of a dmt monitor for characterizing the stationarity of LIGO data. The monitor will study the mean, variance, and fit to a Gaussian distribution, of LIGO data in dyadic sub-bands, in real time. The immediate goal is a Matlab model by 15 Aug 2002. The long-range goal is a dmt monitor by 15 Feb 2003.

Zaleski and Finn completed a Matlab program that reads LIGO frame data, divides it into dyadic sub-bands, finds the mean and variance of sub-sequences in each band. The Matlab program creates a "movie" of how the fit evolves with time and was used in a small way as part of the burst group analysis of S1 data.

b) Numerical Relativity and LIGO Data Analysis

> Finn will organize, under the auspices of the Center for Gravitational Wave Physics, a workshop that will focus on how numerical relativity can contribute to gravitational wave data analysis, modeling and interpretation. This workshop is targeted for Fall 2002.

The CGWP held a workshop entitled Gravitational Wave Source Simulation and Data Analysis. The three day meeting was held 28-31 October 2002 in State College. The meeting drew together approximately equal numbers of astrophysicists and data analysts. The talks focused on the astrophysics associated with potential gravitational wave sources; the between-talk discussion focused on how that science could be targeted by gravitational wave data analysis.

c) Identifying high-order moment correlations

> Summerscales (graduate student), supervised by Finn, will develop a test for high-order correlations in time series data. The goal is a quick-look tool for identifying bi-linear couplings in the LIGO data. A Matlab model code has already been developed. The immediate goal (for 15 Aug 2002) for this period is a technical report describing the test and characterizing its sensitivity; the long-range goal (for 15 Feb 2003) is a dmt monitor implementation.

Summerscales completed development of a Matlab-based test for high-order correlations to be used to identify bi-linear couplings in LIGO data has been developed. The effectiveness of the test has been characterized and the results have been compared with those of the bispectra. A draft LIGO technical report and publication on the test is in preparation.

d) DatacondAPI development

> Finn will continue to participate in the datacondAPI development, with special emphasis on the development and scientific validation and verification of new methods for treatment of instrumental artifacts. The immediate goal is the scientific V&V of line removal using system identification techniques. Finn will supervise Searle (ANU) in this task.

Finn continued to participate in the datacondAPI development, but turned-over leadership of the group to Philip Charlton. Searle's thesis took his work in a different direction that anticipated here and he did not work with Finn on V&V of the jointly developed line removal techniques.

e) Kalman filter for violin mode line removal

> Rotthoff (undergraduate), supervised by Finn, will complete the implementation, testing, characterization and documentation of the Kalman filter actions for violin mode line removal in the datacondAPI.

The Kalman filter action was not completed. This task has taken much longer than anticipated. Completing it will be a high priority focus for the next 6 months.

f) Detector sensitivity monitor

> Schlaufman (undergraduate), supervised by Finn and Sutton, will complete the development of a dmt monitor that evaluates the sensitivity of the LIGO data by computing the instantaneous volume that the detector is sensitive to inspiraling binary neutron stars within (under the assumption of normal noise), and the integrated volume-time sensitivity of the detector. A preliminary monitor has been completed: during this period the immediate goal (for 15 Aug 2002) is improvement in the monitors accuracy, implementation of database and web reporting, and interface with the dmtviewer.

Schlaufman, Sutton and Finn completed development of the DMT monitor sensemon, which computes on the fly from frame data and detector calibration the instantaneous volume throughout which a given detector is sensitive to.

g) `Rayleigh' Monitor

> Sutton (Postdoc) will complete the graphical user interface to the Rayleigh monitor, write a technical report describing the monitor, its functioning, the interpretation of its output, and examples of its use. He will travel to both LHO and LLO to demonstrate the monitor in the control room and train operators in its use.

Sutton completed the Rayleigh monitor GUI. The technical report on Rayleigh monitor was not completed in this reporting period.

h) Template analysis

Tibbits (undergraduate), supervised by Finn, will develop a data pipeline that analyses LIGO data for events loosely characterized by templates derived from, e.g., the Zwerger-Mueller catalog and other sources. The immediate goal is a data pipeline competed by 15 Aug 2002.

Tibbits was re-directed toward the development of a set of LAL tools based on Matlab functions, which will enable the more rapid movement of Matlab prototype code to LAL DSOs. The first example use of these tools was the development a DSO implementation of the block-normal analysis, described below.

i) Block-normal analysis for bursts

Stuver (graduate student), supervised by Finn, will develop a prototype of a novel data analysis method for searching for gravitational wave bursts, based on the identification of change points in stationary data. The prototype will be characterized. Together with Hepler (undergraduate) and Tibbits (undergraduate), this prototype will be converted into an LDAS datapipeline and constitute a new addition to LIGO's burst search capabilities.

Stuver (graduate student), supervised by Finn, has developed a prototype of the block normal data analysis method for searching for gravitational wave bursts, based on the identification of change points in stationary data. The prototype thus far has been characterized using step function changes in data and is currently being prepared for mock data challenges simulating different kinds of burst data. Together Tibbits (undergraduate), this prototype has been converted into an LDAS datapipeline and constitutes a new addition to LIGO's burst search capabilities. The work done at this point was presented at the August LSC meeting at LHO.

Hepler (undergraduate) completed six C++ classes and integrated them into the LDAS datacondAPI: Wavelet, Haar, Resolver, Result, and Reconstructor. Using a Wavelet of type Haar, an input signal can be broken down into pieces by frequency and partially or fully reconstructed. Associated with these classes are the actions Haar, Resolve, getResult, and Synthesize which allow for a user interface. These actions will form part of the data analysis pipeline that includes block-normal and which will be used in LIGO data analysis.

j) Administration

Finn will continue to serve on the LSC executive committee.
Finn will continue to serve as the GWIC executive secretary
Finn will continue to serve as co-Chair of the unmodeled source analysis group.
Finn will continue to represent the PSU tier 2 center on the LSC Comp Coord Comm.
Finn will supervise the development of the PSU tier 2 center and participate in the iVDGL collaboration as co-Chair of the applications task group.
Finn will continue to serve on the LIGO Software Coordination Committee (this committee has not met in the most recent reporting period but has not been dissolved).
Finn will supervise and participate in all the work described in this Attachment, with particular emphasis on those projects where a student is involved.

Finn continued in all these capacities, except that he resigned as co-chair of the iVDGL Applications Task group owing to lack of time.

k) LIGO/SWIFT Collaboration

Finn will represent LIGO on the SWIFT Science Team. Working with Krishnan (graduate student) and Sutton (Postdoc), he will develop a figure of merit that characterizes the sensitivity of the LIGO/Swift instrument pair to gravitational waves from gamma-ray bursts for different Swift pointings relative to LIGO's orientation.

Krishnan, Sutton and Finn have completed work on the figure of merit and a manscript describing the figure of merit is with Finn for final editing before submission to Astrophysical Journal.

Advanced Data Analysis

l) Network Analysis

Finn will collaborate with Dhurandhar and Lazzarini on the development and implementation of network data analysis methods for LIGO.

Finn has not participated significantly in this work over the last six month period.