LSC Six-Month Progress Report

Organization Cornell University Relativity Group

Report Date 08/15/1999

Attachment A - LIGO I

Item - Task 8 - item 8a

ROBUST METHODS FOR STOCHASTIC BACKGROUND DETECTION

This project is a collaboration between Allen, J. Creighton, Flanagan and Romano. The optimum detection statistic for white noise with a non-Gaussian component was originally derived from both the frequentist and Bayesian viewpoints by Flanagan. Later Allen gave a simplified frequentist derivation. The behavior of the statisic has been verified by MATLAB Monte-Carlo simulations by Romano. [The statistic is optimal when the detection signal-to-noise ratio is near the detection threshold, but will not be so if the signal-to-noise ratio is of order a thousand.] Recently the analysis was extended to derive the optimal statistic for colored noise, for a specific model of the non Gaussian behavior.

The Bayesian analytic analysis also clarified the situation in the simpler context of purely Gaussian noise, where it had been suggested that the usual cross-correlation statistic was not in fact optimal, and that a particular Maximum Likelihood statistic (MLE) was superior. There are in fact different versions of MLE, a version A which assumes an unrealistic amount about the detector noise, and a version B which does not. The analysis shows that the cross-correlation statistic is essentially same as the relevent version B of the MLE statistic. Notes on this topic can be found at http://astrosun.tn.cornell.edu/faculty/flanagan/stochas.ps

A paper is in preparation on this subject and should be completed by the end of the summer.

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Item - Task 8 - item 8b

DETECTION OF NON-GAUSSIAN STOCHASTIC BACKGROUND SOURCES

There is no progress yet on this item, but we expect that the analysis methods developed in the last item above can be applied to this situation.

In addition, Allen, Flanagan, and Papa recently completed a paper refuting Grischuk's claim that the non-stationarity of a stochastic background produced by inflation is detectable. The paper is availble from xxx.lanl.gov/gr-qc/abs/9906054.

Item - Task 8 - item 8c

EXCESS POWER STATISTIC

The paper on this topic is in preparation and will be submitted during the summer. It contains (i) a derivation of the excess power statistic from the Bayesian viewpoint (ii) a monte carlo simulation of the properties of the statistic which verifies its expected behavior (iii) detailed quantitative comparisons of the performance of this method versus matched filtering, for the specific application of detecting binary black hole mergers, and (iv) an extension of the algorithm to the multi-detector context (assuming Gaussian noise).

Item - Task 8 - item 8d

LITERATURE SEARCH FOR BLIND SEARCH TECHNIQUES

This task has not yet been completed but will be completed by August 1999.

Item - Task 8 - item 8e

MOCK DATA RUN ON NOVEMBER 1994 DATA SET

Allen (UWM) is in the process of organizing a mock coincidence analysis of the November 1994 data set, where the data has time delays inserted in order to mimic the situation where one has two separate instruments. The Cornell group has not yet contributed to this project but plans to in the next 6 month period, in particular to the development of discriminators/vetos.

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Item - Task 8 - item 8f

EXPLORATION OF METHODS TO INCREASE ACCURACY OF POST-NEWTONIAN TEMPLATES

Calculations by Tichy and Flanagan showed that the idea of solving the eqations of motion numerically rather than using the explicit analytical post-Newtonian solutions does not increase the accuracy of solutions. This was deduced by comparison to the perturbation theory results in the limit of vanishing masses of one of the particles. Thus this idea will not be pursued further.

Item - Task 8 - item 8g

LSC ASIS/DCSA GROUPS

The Cornell group is continuing to help organize the LSC subgroups ASIS and DCSA. Flanagan completed his stint as secretary of ASIS, the last minutes being taken at the March LSC meeting. Warren Anderson of UWM has now taken over as secretary. In addition, Flanagan contributed to the LSC white paper on data analysis, writing with Romano a preliminary version of the section on stochastic sources.

Item - Task 8 - item 8h

RESEARCH RELATED TO LIGO FACILITIES -- LIGHT SCATTERING NOISE

Flanagan is continuing to work on paper I, describing the foundational theory, and is on track to turn it over to Thorne by August 1999.

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Item - Task 8 - new item

DETECTION THRESHOLDS

For inpsiral searches, the setting of appropriate detection thresholds in the multi-detector non-Gaussian context will be a sufficiently complicated task that it will be difficult to establish these thresholds using Bayesian methods, and we will need to use frequentist methods. However, relying solely on frequentist methods can be risky, because of an effect known to stisticians as Lindley's paradox. Flanagan wrote a set of notes explaining these risks (amplifying earlier work by Finn) and circulated them to the ASIS group; they can be obtained at http://astrosun.tn.cornell.edu/faculty/flanagan/notes.ps

Item - Task 8 - Personnel

During the next six months, Cornell incoming graduate student Steve Drasco will join our group. Drasco was an undergraduate CERF student with Roy Williams at Caltech and has extensive experience working with GRASP.

Also, this report was written slightly more than halfway through the period of the 6 month plan.

Note 1, Linda Turner, 02/28/00 02:36:48 PM
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