LSC Six-Month Progress Report

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a) Construction of IOO (Input Optics) box

Using the LOS/SOS boxes that we constructed in the last LSC period, we started constructing an e2e box to simulate the input optics (the IOO box). Currently, the IOO box contains a SM (steering mirror) box and a MMT (Mode Matching Telescope) chain box. The MMT chain box consists of two SOS boxes representing MMT1 and MMT2, and one LOS box representing MMT3. By giving a realistic table-top motion to each of these boxes as the mechanical input and an optical field to the SM box as the optical input to the IOO box, we simulated the pointing fluctuation of the output laser beam to the beam splitter. When the optical input was mechanically quiet, the pointing fluctuation of the IOO output beam shows the same level of optical coupling to higher order modes as analytical estimation. We found two bugs in the e2e and reported to the e2e simulation group at the LIGO Lab, Caltech.

b) Estimation of HAM table top motion

We continued estimation of the HAM table-top motion using the LOS and SOS e2e boxes. The translational table-top motion was estimated from a theoretical, suspension-point-to-pendular-motion transfer function of a small optic and its actual pendular motion recorded via the data acquisition channel at LLO. We gave this table motion to the e2e box representing a large optic on the same table, and compared the calculated pendular motion of the large optic with its actual motion recorded concurrently with the small optic's pendular motion. If the table-top motion is estimated correctly, the calculated and recorded large optic's motions should be close to each other. We preformed this test for various local damping gain settings. Consequently, we found that the power spectrum of the calculated pendular motion showed good qualitative agreement with the experimental power spectrum. We performed the same test for the yaw degree of freedom. However, the agreement between the resultant numerical and experimental power spectra is not as good as the case of the pendular degree of freedom. We suspect that this is at least partly because the optic's yaw motion is coupled with the pendular motion via imperfect diagonalization of the local damping servo matrix; i.e., when the local damping control signal corrects the pendular motion, it excites yaw and pitch motion due to imbalanced gain in the coil actuators. It is necessary to model this effect properly in the e2e simulation so that theoretical transfer function in the yaw motion becomes more realistic. We will continue this investigation.

We reported some of these results at the 70th annual meeting of the Southeastern Section of American Physics Society (Wilmington, NC, 6 Nov, 2003).