LISA is an array of three spacecraft in an approximately equilateral triangle configuration which will be used as a low-frequency gravitational wave detector. We present here new generalizations of the Michelson- and Sagnac-type time-delay interferometry data combinations. These combinations cancel laser phase noise in the presence of different up and down propagation delays in each arm of the array, and slowly varying systematic motion of the spacecraft. The gravitational wave sensitivities of these generalized combinations are the same as previously computed for the stationary cases, although the combinations are now more complicated. We introduce a diagrammatic representation to illustrate that these combinations are actually synthesized equal-arm interferometers.