# Accelerometer-Assisted Tracking and Pointing for Deep Space Optical Communications: Concept, Analysis, and Implementations

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**Abstract**:

NASA/JPL has been developing technologies for deep space tracking and pointing of an optical communication beam using linear accelerometers. Linear accelerometers provide excellent accuracy in sensing the vehicle's acceleration with an advantage of small size, low cost, and a broad range of well developed products.

Accurate and stable pointing is the most critical function necessary to establish a successful free-space optical communication link. Generally known as the line of sight problem, it is also common to image stabilization. The most dominant mis-pointing error source is the spacecraft vibration which causes line-of-sight jitter during beam pointing. Line of sight stabilization using the detection of spacecraft vibration has been previously pursued with gyros, angle sensors, and more recently, angular rate sensors.

The goal of this research is to achieve sub-microradian pointing without relying on ground based laser beacon or extended sources, such as Sun-illuminated Earth or Moon. Moving away from using these beacon sources is preferred because they have several fundamental limitations such as low intensity for a large range and albedo variations. Unlike these beacon sources, star trackers can provide steady light intensity for most of the time. The only drawback is the low light level which limits the reference updates to less than 20 Hz using 10th magnitude stars. However, this can be compensated by using the combination of star trackers and accelerometers to provide sufficient reference update rates that can command the pointing mechanism to compensate for the spacecraft vibrations.

In this paper, we will present the concept of accelerometer assisted tracking, the theoretical analysis, and the progress made on its implementation.