

A Comparison Of Laser Based Ranging Systems For AR&C Category I: Hardware

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N 93 - 522378
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Abstract:

The benefits of incorporating range information in space applications come in several areas. For example, in automatic docking systems range maps are useful to resolve ambiguities in target identification, while for maneuvering, closure and docking in space vehicles, ranging systems are highly useful for quantitative assessment of the proximity environment as well as simple qualitative knowledge for obstacle avoidance, alarm functions, etc. Many optical techniques have been proposed for these applications, with varying degrees of expected performance and effectiveness. With the recent addition of laser-sensor technology to the automation tool-box, very compact and simple robotic sensors are now available.

From the earliest LED/detector combinations to the latest laser radar and fiber optic techniques, electro-optical technology has proven its utility. It is possible, with time-of-flight, TOF, CW-Tone modulated and FM-CW coherent laser radars to measure fractions of a centimeter or less with speeds in the 10's to 100's of samples per second from short to considerable range. However, the practical behavior of these techniques has not always been as good as expected. An analysis of each of these techniques will be given that includes the effects of laser performance on the ability of the systems to perform their ranging function.

This paper will present some aspects of the effect of inherent laser effects on the performance of these two techniques. It will be shown that performance of these techniques is affected in different ways inherent laser characteristics and previous comparisons of the techniques should be modified to reflect more realistic conditions.

An overall survey of laser ranging will be given to place the CW and FM-CW techniques in perspective. It will be seen that the newly introduced FM-CW laser radar has potentially far superior performance to CW-Tone modulated systems now proposed for use in space rendezvous and capture systems.