

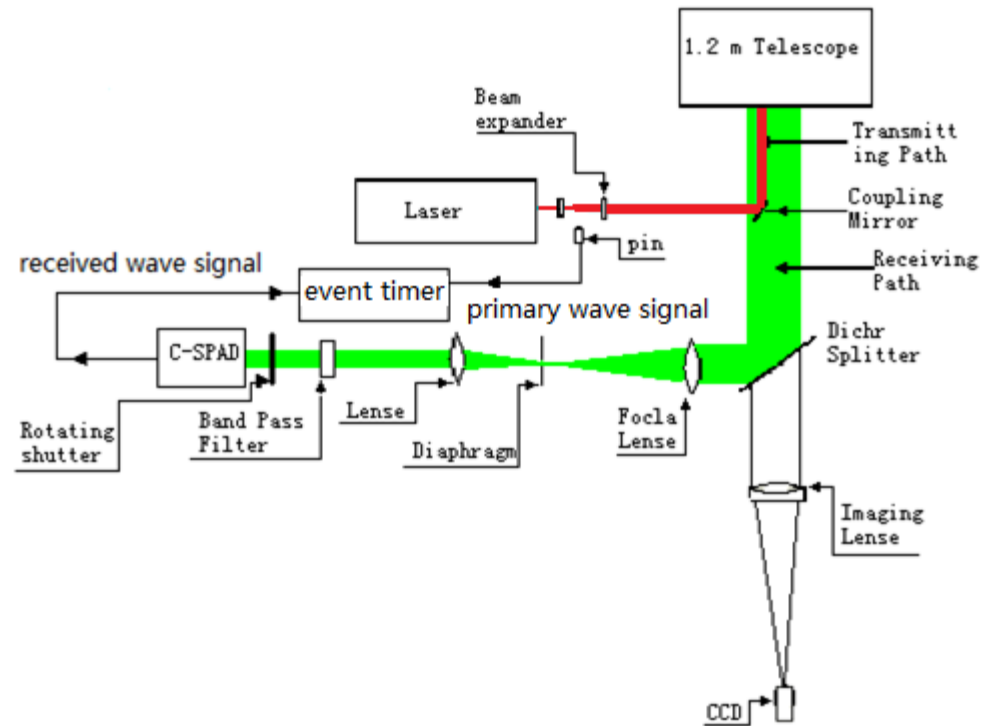


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# Simulation and Research of Transmitting and Receiving Epoch Overlapping Phenomenon on Co-Optical Path KHz Laser Ranging System

**Zhai Dongsheng, Li zhulian, Fu Honglin, Zhang Haitao, Huangtao  
, Li Yuqiang, Zhang Yuncheng, Xiong Yao heng**

# KHz Co-optical Path System



1.2m telescope is used as both transmitted and received instrument

# Rotating Shutter

A Key Technology :

Rotation Shutter

- 1、 to achieve the switching between emitted and received optical path.
- 2、 to generate synchronization pulse of fire signal
- 3、 to reduce backscatter noise of emitting laser to SPAD
- 4、 let return photo to receiver, .....



# Condition of overlapping phenomenon

High level : the system is in receiving optical path

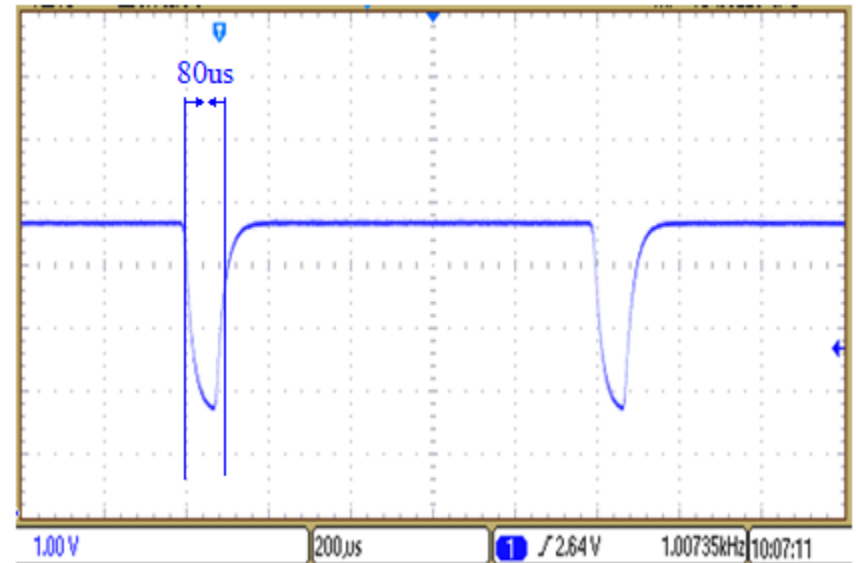
Low level: the system is in emitting optical path

The duration of low level :  $80\mu\text{s}$

The instantaneous ranging frequency :  $1007.3\text{Hz}$   
(belonging to KHz laser ranging)

If the receiving epoch is in the duration of low level ,the overlapping occur. So the condition of overlapping can be represented by this approximate formula :

$$\begin{cases} t_r - t_t < 80\mu\text{s} \\ t_r - t_t \geq 0 \end{cases} \quad \begin{array}{l} t_r : \text{receiving epoch} \\ t_t : \text{main wave epoch} \end{array}$$

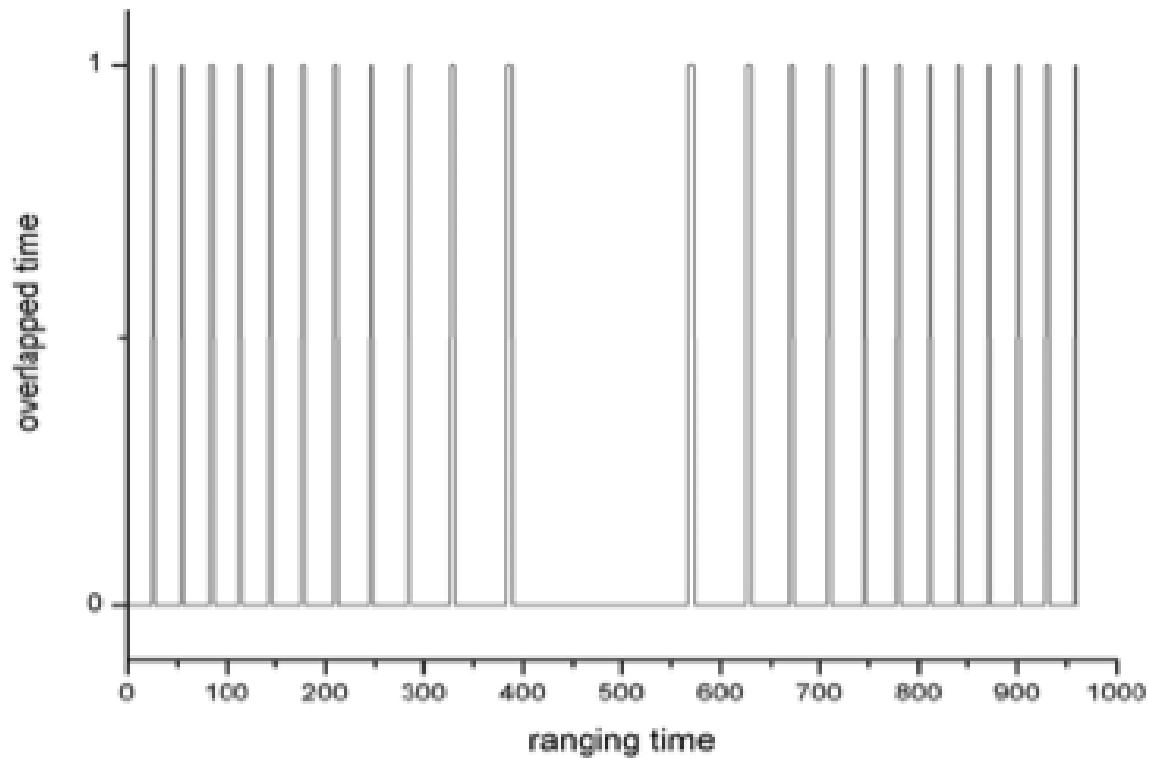


synchronizing signal of shutter with fixed 1007Hz



# The simulation of different orbit target overlapping rate

overlapping propability is 7.144%

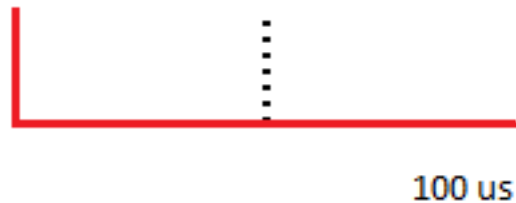


The simulation result of Ajisai

# The way to reduce overlapping rate in 1.2 m telescope

computer identifies and alters automatically

Controlling arithmetic :



**The formula of given frequency :**

$$f = f_0 + A_c \times \cos\left(\frac{\pi}{2} \times (t_r - t_t)\right)$$

$f_0$  : initial frequency (KHz)

$A_c$  : amplification of frequency variation  
(Hz unit)

— The current main wave epoch  
- - - - The epoch of forthcoming echo signal



## The results of target tracking experiment without shutter control

Satellite	Orbit	Rotating Shutter	Frequency (Hz)	Probability (%)
Beacon	LEO	Un-controlled	1010.87	11.6594
Lageos1	MEO	un-controlled	1006.57	8.9797
Glonass11 8	HEO	Un-controlled	1007.52	5.508

Overlapped probability without shutter control



## The results of target tracking experiment with shutter control

Satellite	Orbit	Rotating shutter	Frequency (Hz)	probability ( % )
Beacon	LEO	Controlled	1007.294	0.4738
Lageos1	MEO	Controlled	1005.648	0.0809
Glonass118	HEO	Controlled	1007.037	0.2253

Overlapped probability with shutter control

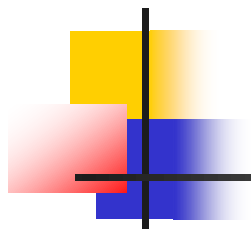




## Conclusion

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- 1、 The overlapping probability is greater than 5.0% when the rotation shutter is not controlled by computer.
- 2、 The overlapping rate is less than 0.5% with control.  
Consequently:  
The overlapping probability can be reduced by this way.



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Thank you for your attention