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Use of REE interpolators with RLE10 laser interferometer encoder system

Overview

RLE laser interferometer based encoder systems can directly produce output signals in differential digital RS422 and/or 1 Vpp analogue sine/cosine formats.

The 1 Vpp analogue signals can be externally interpolated by a variety of means to produce very high resolution position feedback signals. To perform this interpolation, Renishaw offer the RPI20 parallel interface and the REE range of interpolators (which were designed for use with Renishaw's range of optical tape encoders).

This application note summarises a series of tests that have been undertaken to determine the performance of the REE product range when used with an RLE laser encoder system.

The REE interpolators tested were:

Part number	Interpolation factor	Maximum output bandwidth (MHz)	Theoretical output resolution* (nm)		Maximum velocity (mm/s)***	
			PMI**	RRI**	PMI	RRI
REE0040A06B	40	6	3.955	7.910	14.7	29.5
REE0100A20B	100	20	1.582	3.164	17.7	35.4
REE0200A20B	200	20	0.791	1.582	8.8	17.7
REE0400A20B	400	20	0.395	0.791	4.4	8.8

Table 1: Interpolator models

* See 'Performance theory' for information on how these values are derived

** PMI = plane mirror interferometry; RRI = retroreflector interferometry

*** Maximum velocity is limited by the analogue input bandwidth of REE

Test overviews

In all tests, a signal generator was used to simulate the fringes normally generated, detected and processed with the RLD10 detector head.

Pulsed count integrity and error signal

These tests were performed to:
- determine the maximum operating speed
- check initiation of the error signal

A signal generator was used to produce bursts of analogue sine and cosine waveforms following an external trigger. These pulses, which simulate the fringes generated within the RLD10, were received by the RLU10, passed to the REE under test and then onto a quadrature counter. The peak to peak voltage was varied to simulate changing signal strength.

The known number of cycles produced by the signal generator resulted in a known number of input counts on the counter. Thresholds for miscounts and error signals were calculated at different input frequencies. Monitoring of input count and error status ensured the REE did not lose counts without an error signal being asserted. This was repeated at various signal strengths. The result of testing showed that the system worked down to a signal strength of 25% to the velocities shown in table 1.

Application note

Performance theory

Theoretical output resolution can be calculated as: $R = R_{RLE} / n$

Where:

R = system output resolution achievable with the inclusion of an REE
(at NTP: 20 °C, 1013.25 mbar and 50% RH)

R_{RLE} = analogue output resolution of the RLE system at NTP

n = REE interpolation factor

Note: analogue output resolution is dependant on the target optic used, and the system axis under consideration. See RLE fibre optic laser encoder installation guide (Renishaw part no. M-5225-0568) for analogue output resolutions of the RLE.

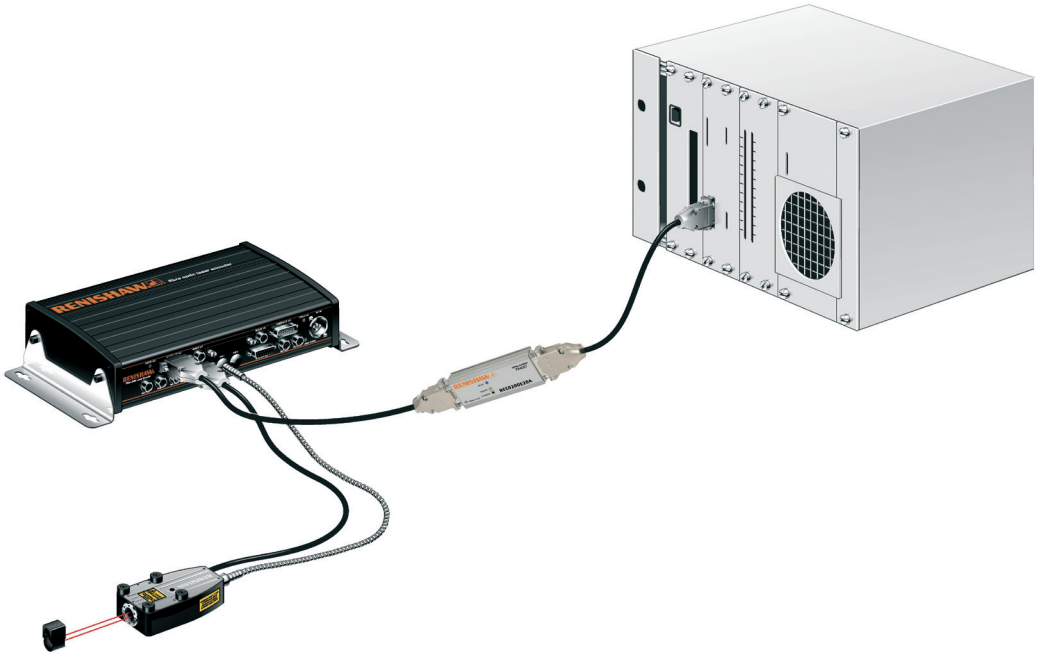

Figure 1: Interpolator integration within an RLE system

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Renishaw is an established world leader in engineering technologies, with a strong history of innovation in product development and manufacturing. Since its formation in 1973, the company has supplied leading-edge products that increase process productivity, improve product quality and deliver cost-effective automation solutions.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Products include:

- **Dental CAD/CAM scanning and milling systems.**
- **Encoder systems for high accuracy linear, angle and rotary position feedback.**
- **Laser and ballbar systems for performance measurement and calibration of machines.**
- **Medical devices for neurosurgical applications.**
- **Probe systems and software for job set-up, tool setting and inspection on CNC machine tools.**
- **Raman spectroscopy systems for non-destructive material analysis.**
- **Sensor systems and software for measurement on CMMs (co-ordinate measuring machines).**
- **Styli for CMM and machine tool probe applications.**

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