Computing Resolution

Ball-Screw-Driven Linear Translation Stage With Rotary Encoder

To determine the machine resolution (R) of a linear translation stage with a ball screw and an amplified sine output rotary encoder, the following information is required:

P — The pitch of the ball screw [expressed in mm/rev (in/rev)]

C — The number of pulses per rev of the rotary encoder (encoder pulses/rev)

MF — The multiplication factor of the MXH multiplier (pulses/encoder cycle)

Note: MF = 1 for line driver output encoders

Q — Multiplication factor resulting from the controller (counts/pulse)

Note: All Aerotech controllers perform quadrature on encoder signals; therefore Q = 4

Once all of this information is available, the following equation can be used to determine linear resolution.

$$R = P \div C \div MF \div Q$$

EXAMPLE:

P = 4 mm per rev
C = 1000 cycles per rev
MF = 10 pulses/cycle
Q = 4 counts per pulse
R = 4 (mm/rev), 1000 (cycles/rev), 10 (pulses/cycle), 4 (counts/pulse)
R = 0.0001 mm/count
R = 0.1 µm per count

Ball Screw or Linear Motor Driven Linear Translation Stage with Linear Encoder

To determine the machine resolution R of a linear translation stage with an amplified sine output linear encoder, the following information is required:

GP — The grating pitch (distance travelled in one complete electrical cycle) of the encoder (LT and LE encoders – 20 µm per cycle, LNencoder – 4 µm per cycle).

MF — The multiplication factor of the MX multiplier (# pulses/encoder cycle)

Note: For encoders specified as LTxxX5, MF = 5; LTxxX50, MF = 50

Q — Multiplication Factor resulting from the controller (counts/pulse)

Note: All Aerotech controllers perform quadrature on encoder signals; therefore Q = 4.

Once all of this information is available, the following equation can be used to determine linear resolution:

$$R = GP \div MF \div Q$$

EXAMPLE:

GP = 20 µm per cycle (LT encoder)
MF = 50 pulses/cycle
Q = 4 counts per pulse
R = 20 (µm/cycle) ÷ 50 (pulses/cycle) ÷ 4 (counts/pulse)
R = 0.1 (µm/count)

Rotary Stage with Encoder

To determine the machine resolution (R) of a worm gear driven rotary stage with an amplified sine output rotary encoder, the following information is required:

TT — Tabletop travel (360°/ttrev)

WGR — Worm gear ratio [number of motor revolutions required for one tabletop revolution(mrev/ttrev)]

Note: WGR = 1 for direct drive tables

C — The number of cycles per revolution of the rotary encoder (encoder cycles/rev)

MF — The multiplication factor of the MXH multiplier (number pulses/encoder cycle)

Note: MF = 1 for line driver output encoders

Q — Multiplication factor resulting from the controller (counts/pulse)

Note: All Aerotech controllers perform quadrature on encoder signals; therefore Q = 4

Once all of this information is available, the following equation can be used to determine rotary resolution:

$$R = TT \div WGR \div C \div MF \div Q$$

EXAMPLE:

TT = 360 °/ttrev
WGR = 54 (mrev/ttrev)
C = 1000 cycles per rev
MF = 1 pulse/cycle (no multiplier)
Q = 4 counts per pulse
R = 360 (°/ttrev), 54 (mrev/ttrev), 1000(cycles/mrev), 1 (pulse/cycle), 4 (counts/pulse)
R = 0.00166°/count or 6.0 arc sec/count