SynQNet™
Features & Capabilities

Minimizing Jitter & Skew

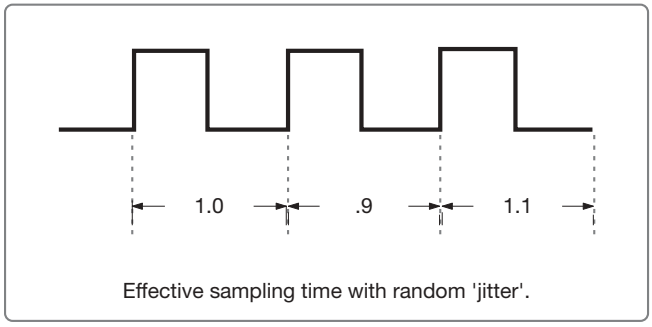
Helping you build a better machine, faster.™

Introduction

Skew and Jitter exist in all digital network systems. When machine builders use a network to connect motion controller and drive, they should to be aware how skew and jitter will effect the performance of their machine. This tech note explains jitter and skew and why it is important to minimize them in high performance and high precision motion systems.

What is "Jitter" ?

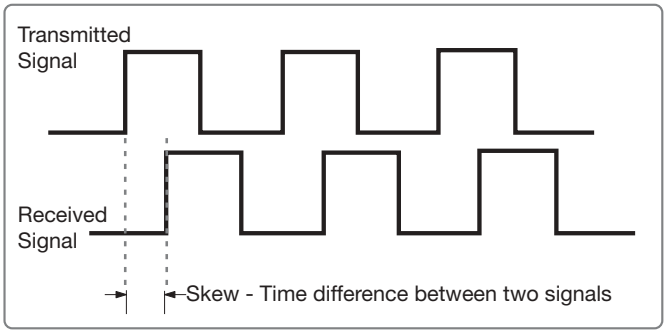
In any networked system there are transmitters and receivers, often multiples of each. The transmitter sends out data onto the network at a rate determined by its internal clock and digital logic. The receiver independently samples this data at a rate that is determined by its internal clock and logic. Due to natural variances and inherent limitations of any digital sampling system, the effective sample time will differ from cycle to cycle. This difference is referred to as jitter. Graph A shows a simple abstraction of jitter.



Graph A

What is "Skew" ?

Skew is simply the data propagation delay between any two nodes on the network. When a transmitter sends data it must be processed by the transmitter's digital logic, and when it is received it must be processed by the receivers digital logic. Although these processing times are very small, they do result in an effective propagation delay between data being transmitted, and data being interpreted and acted upon. Graph B shows a simple abstraction of skew.



Graph B

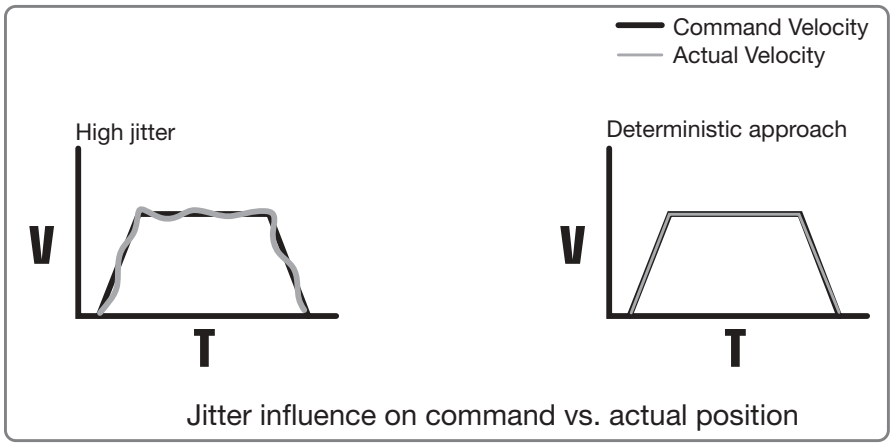
Why Is Low Jitter Important

Applications requiring accurate velocity control such as wafer scanning or dispensing will be adversely affected by the random velocity errors that jitter introduces. In a theoretically perfect digital system, the sample periods are identical and a motor traveling at constant speed delivers a regularly increasing position count every sample period. Since jitter introduces a random time deviation between sampling periods, a motor that is physically traveling at a constant velocity will appear – to the control system - to be moving with random variations in velocity. This is because the incremental position count will vary from sample to sample. A closed loop control system will work to reduce the random variations to achieve a constant number of incremental position counts per sample cycle. Because the sample periods are not identical – due to jitter – the result is a motor that rotates with some random variation in velocity. Graphic C illustrates a simple trapezoidal velocity profile and the influence of jitter.

Why Is Low Skew Important

Applications requiring accurate path motion such as machining, wirebonding or scanning will be adversely affected by both random and systematic errors introduced by jitter and skew.

In a multi-axis system the accuracy of a path motion will be determined by how accurately each axis is independently controlled, and also how accurately the axes are coordinated. We have already seen how jitter affects individual axes. Skew is detrimental in a different manner. In a 'perfect' multi-axis control system every axis in the system receives a command at the same absolute time, and every axis reports back its position at the same absolute time. In traditional



Graphic C

high performance analog systems the skew between axes is minimal because every drive has its own analog command, and its own encoder feedback channel. In a networked system, each drive must share the same network channel to receive command data and transmit position data back. The skew between axes, for both the transmitted command data and the returned position data, results in systematic errors in path motion. See graphic D.

SynqNet Reduces Skew and Jitter

SynqNet has been specifically designed to replace the ±10V analog command signal – between controller and drive - without compromising motion precision or performance. SynqNet is a synchronous network that employs a centralized motion controller to transmit regular synchronization data to every node around the network. Each receiving node uses advanced digital time-correction techniques to minimize both skew and jitter to levels that are comparable to or better than high performance analog systems.

Noise immunity & Isolation

Traditional analog systems, especially high resolution systems, are susceptible to interference from electrical noise which leads to random disturbance in the axis motion. With the reduced wiring inherent in a SynqNet network, and the all-digital nature design, any jitter induced by electrical noise is greatly reduced. In addition, the robust electrical isolation features of IEEE802.3 prevents noise-inducing ground loops and voltage differentials between system components.

Graphic D

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