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IEEE 1588 Lowers Integration Costs in Continuous Flow Automated Production Lines

Keywords

Automotive, Robotics, Networking, Line Synchronization, Material Handling, IEEE 1588

Summary

The IEEE 1588 "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems" is a viable foundation for standardizing the way modular machinery is interconnected. Network services available with the IEEE 1588 standard will enable rapid integration of modular machinery that will operate in precise synchronization. Robotic production lines are excellent automation candidates for utilizing the capabilities of IEEE 1588 as they are widely used in continuous flow operations for discrete products and perform tasks while work in process are still in motion.

Manufacturers are in pursuit of automation solutions that increase productivity through higher line speeds while maintaining the agility necessary to handle a wide range of products. IEEE 1588 enables such performance by providing precise synchronization among modular machine sections while reducing life cycle cost.

Analysis

Many automated production and warehouse applications such as assembly, welding, printing, or material handling are traditionally implemented with centralized command and control centers, making them costly to integrate and difficult to support. However, the market is shifting as end users are in pursuit of automation solutions that offer continuous flow operation for discrete products to increase productivity though higher line speeds, while maintaining the agility necessary to handle a wide range of products. Machine builders are responding in parallel to these functional requirements with modular machine designs that allow end users to configure manufacturing systems based on functional subsystems.

Modular Machine Synchronization

The overall effect of this trend is that modular machine designs are driving the need for both the distribution of machine and enhanced production line

controls. To achieve this requires coupling and coordination of modular machine units either through industrial networks or proprietary hard wired data links. A very promising standard, the IEEE 1588 "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems" has emerged in this arena. In short, IEEE 1588 defines a standard method for synchronizing clocks in measurement and control devices in distributed networked systems. Most importantly, the network services defined in the IEEE 1588 standard are network independent, but the underlying requirement is that each machine control system must have a precise and stable clock. Consequently, a wide range of industrial networks will be able to implement the IEEE 1588 standard and enable the application program to remain consistent regardless of the network. The benefits to the end user are lower integration costs and improved consistency in implementations.

Robotics Are an Ideal Application

Robots are excellent automation candidates when implementing continuous flow by performing a task while subassemblies or work in process are still in motion. By synchronizing the robotic motion with the conveyors within its operating zone the overall productivity is further increased. Algorithms to synchronize robotic operation in reference to a moving conveyor enable such operation, even if conveyor speed changes continuously. Eliminating start and stopping operation of conveyors increases the average line speed by making parts move continuously. IEEE-1588 could enable operation with ease and in an open environment.

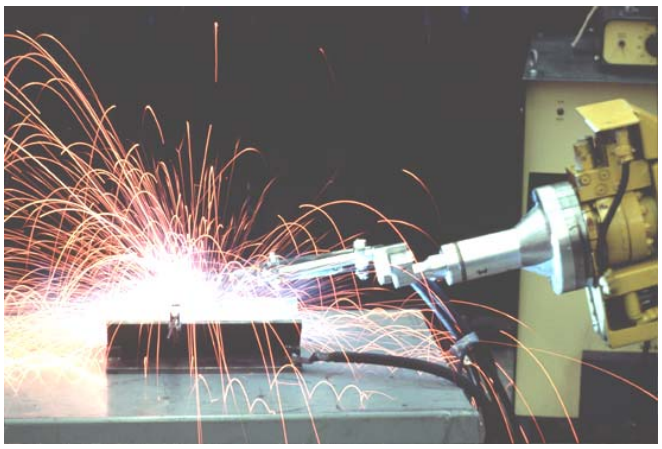
Increased productivity
Higher reliability
Lower integration cost
Non-proprietary approach
Synchronization of multi-vendor robots
Lower maintenance
Higher Return On Assets
Reduced life cycle cost

Advantages to Using IEEE 1588 in a Robotic Line

Robotics are widely used in the automotive industry for automated assembly, welding, painting fabrication, and production lines. Consequently, automotive manufacturers are constantly searching for ways to increase production or transfer line speeds for faster return on assets (ROA). Raising the speed notch by notch on every section or station of a production line to the point beyond which production quality might suffer or until a process bottle neck is reached is one way manufacturers achieve high line speed. While this is a normal practice opted by manufacturers, it does not raise the line speed to its highest potential. In most of these production lines, the highest productivity is achieved when each section is synchronized with the previous station or

other devices in a manner that it eliminates dead time. For example, coordination between the robot loaders/unloaders and presses can be made very efficient by controlling inter-device coordination, increasing throughput significantly. In many operations robots need not wait for a part to come to a complete stop in its operating zone to perform task on it.

Hard wired schemes to follow encoder or other devices, generally a proprietary approach, are normally used to implement synchronized robot operations. Compared with this proprietary hard wired encoder approach, robots with network interfaces that support IEEE 1588 synchronization capabilities are able to lower the overall total cost of ownership (TCO) of an automated line by increasing productivity, raising performance, improving reliability, reducing integration and start-up time, and lowering maintenance cost.



Employ Continuous Flow Production with Robotics

The ability of a robot to perform a task on a moving target has wide implications in many manufacturing industries, from welding car body frames or applying glue to a windshield on an automated assembly line to picking material on a conveyor belt in the warehouse. The standard brings additional benefit to manufacturers who select specialty robots, generally not from the same supplier, to achieve superior performance in modular production line architectures. Built-in IEEE 1588 capability in those robots from diverse suppliers will help achieve synchronized operation with other devices and stations easily and rapidly. Further savings can be realized in two parallel production line operations by sharing the same robots between the two lines. IEEE 1588 enables such operation by networking synchronized signals and eliminating the need to switch encoder wires from one line to another, thereby increasing reliability.

Industrial Networking Groups Rapidly Adopt

The ink on the IEEE 1588 standard was not even dry before ODVA (association supporting network technologies based on the Common Industrial Protocol (CIP) which include DeviceNet, EtherNet/IP and CIP Safety) announced plans to employ this standard in order to add time

synchronization services to DeviceNet and EtherNet/IP. Time synchronization services referred to as CIPsync will be augmented to their Common Industrial Protocol . ODVA's rapid announcement of CIPsync and qualifying its utility in distributed motion control and other highly distributed applications is an indicator that this standard that has been in development for over six years is a viable foundation for standardizing the way modular machinery is interconnected.

Today's ad-hoc custom engineered solutions will be displaced by application programs installed in a machine. The network services available with IEEE 1588 standard will enable rapid integration of modular machinery that will operate in precise synchronization. In effect, many of the safety measures used to balance production or material handling lines with accumulators and diverters will fall by the wayside.

Recommendations

- Users should demand IEEE 1588 capability in their new robotics equipment because it adds agility in adapting future changes in their production line.
- Work with your robotic suppliers and system integrators to share a vision on the use of networking solutions that offer IEEE 1588 synchronization capabilities.
- Assess the costs associated with integrating a robotics line in order to elevate this issue with operations management.

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