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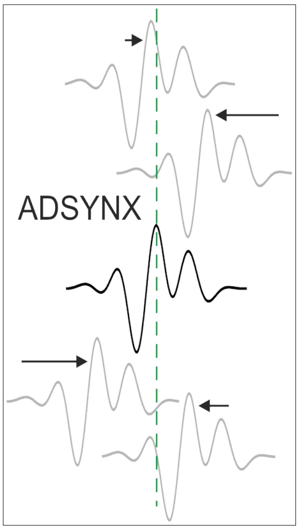
ADSYNX - Adaptive Control Method for Signal Synchronization

The ADSYNX technology provides a fast and adaptive method for the synchronization of different signals (skew compensation) for any electrical or optical system up to the GHz regime.

Challenge



The transmission of electrical or optical signal groups often leads to different travel times and asynchronous arrival at a detector. This can occur due to multiple reasons including, but not restricted to, differences in production (material properties), thermally induced differences, different transmission delays in the system, etc., even if the signal source is identical. In addition, widening of pulse groups or other distortions can happen. Processing of such signals requires prior temporal synchronization for which ADSYNC offers a powerful solution.

Methods based on conventional control mechanisms have various disadvantages based on the type of synchronization. In most cases, recurring calibration is necessary, while at the same time these methods are limited in temporal resolution or concerning the type of signals which can be synchronized.

Our Solution

The present invention suggests a smart method for the synchronization of any number of electrical or optical signals in a fast, iterative and adaptive way. Due to this, the adaptive synchronization system –ADSYNX– does not require any calibration procedure. ADSYNX continuously analyzes the different signal arrival times at the detector and creates a control signal that can be used with any application to shift signal groups accordingly until synchronization is achieved.

Development Status

Algorithm and optoelectronic setup are complete and ready to use. Small adaptations can be done depending on application.

Patent Status

German patent application filed:
DE102022132996.8

Patent holder:
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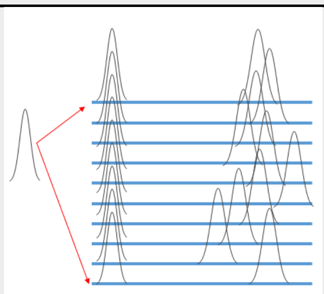
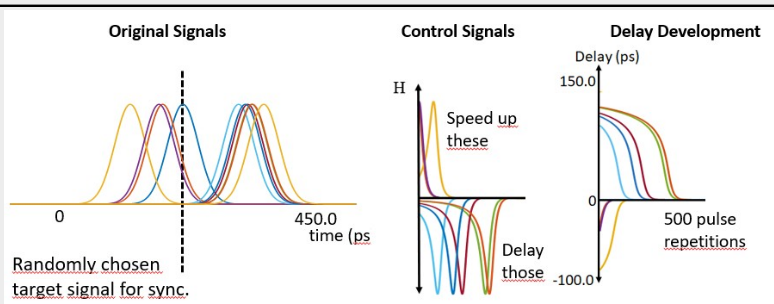
Application example: Compensation of optical signal delays in a fiber bundle



Left top: Synchronous optical input signals get de-synchronized along some cable distance due to temperature and/or fabrication differences. Optical signals obtain realistically about +-200ps pulse-center dispersion for 10km fiber length.



Left bottom: Here we compensate skew in 10 fibers. The lower panels show the original 10 signals at the receiver at start of the experiment (left), the control signals (middle) and the resulting delay development (right) where all delays drop to zero at about 500 pulse-group repetitions. At a carrier frequency of 10GHz this happens after 50ns. Control is performed by adjusting the time of pulse insertion by the laser for the different fibers.

Advantages

- Fast and iterative method
- Adaptive procedure, calibration not needed, flexible response to fluctuating initial conditions
- Usable for any electrical or optical signals
- Modular system: block wise expansion is possible, any possible number of signals can be synchronized
- Implementable in analogue as well as digital hardware

Applications

The present invention is relevant for the fast temporal synchronization of electrical or optical signals. It provides substantial advantage for any application that benefits from synchronous signal input allowing for precise post-processing. The degree of the initial signal skew is not relevant and synchronization does not depend on it.

Example application domains:

- Telecommunication, GPS, Clock-synchronization in wireless transmission, augmented reality, and essentially all systems where synchronous signal transmission is relevant.

Example technologies

- Fiber optic-based transmission systems as well as wire-based or wireless transmission up to the GHz regime.