UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Unitat de Valorització

Optical communication receiver with an SQRT non-linear equalizer

In a high bit rate optical transmission, the inclusion of a simple non-linear equalizer implementing the square-root mathematical function, just after the photo-detector and before the conventional electronic equalizer (FIR, MLSE, analog,..), linearizes the overall systems and highly improves the transmission performances.

The Challenge

Broadband communication networks are nowadays based on optical fiber transmission, where the data signals are transported over a modulated optical carrier. At the receiver, this optical signal is converted into an electrical signal by means of a photo-detector, that generates electrons from the input photons, with an efficiency denoted by the ratio electrons/photons. This is an optical power (Watts) to electrical current (Amperes) conversion, thus non-linear. This implies that the linear distortions suffered during the optical fiber transmission are converted into non-linear distortion at the receiver output, making their treatment complex. The challenge consist of obtaining a linear photo-receiver.

The Technology

The intrinsic square-law non-linear function of the photodiode, relating the optical field amplitude and the generated current, can be partially compensated by means of the non-linear electrical circuit performing a square-root function after the photodiode.

The results in long distance systems, with impairments like chromatic dispersion and ASE noise, have demonstrated a substantial performance enhancement, using FIR or MLSE equalizers in a digital IM-DD, and with Radio-over-Fiber systems.

The device has been implemented with fast shottky diodes in a simple structure, with a MMIC chip with technology GaAs 0.2 um, and with Digital Signal Processor, approximating the SQRT function with low error.

An extended version implements a modified function, that incorporates the optical noise model, and completely transforms it into Gaussian statistics at the photo-receiver output.

Innovative advantages

- Increased bandwidth x distance reach
- Simple and very low cost implementation, specially if integrated with TIA.
- Increase of chromatic dispersion tolerance, by enhancement of conventional EDC capabilities (about +30%).
- Linearization of the effect of other optical impairments, like reflections, optical noise, interferences, etc.
- Eye diagram symmetry and transformation of ASE chi-square statistics into Gaussian.
- Reduced number of required quantization levels for ADC.
- Improved dynamic margin in FTTH PON burst-mode receivers.

Current stage of development

Experimental prototype and validity tests passed.

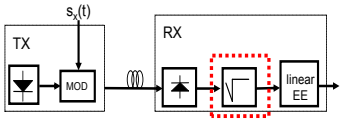
Applications and Target Market

- Optical transceiver manufacturers
- Broadband Telecom System Integrators
- Optical Communication networks: transport, metropolitan, access

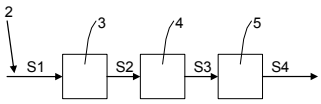
Reference number

MKT2011/0050_I

OPTICAL FIBER TRANSMISSION SYSTEMS WITH EXTENDED PERFORMANCES



SIMPLE MODULE LINEARIZING THE PHOTO-DETECTOR FUNCTION



The non-linear circuit enables to process the optical impairments in the same manner as for the impairments in conventional radio transmission

Business Opportunity

Technology available for licensing, transfering and technical cooperation

Patent Status

Granted

Contact

Mr. Xavier Estaran Latorre
Licensing Manager
T. + 34 934 134 094
M. +34 626 260 596
f.xavier.estaran@upc.edu

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