**Título:** Optimização de Receptores com Pré-Amplificação Óptica para Sistemas de Elevado Débito  
**Title:** Optimisation of Preamplified Optical Receivers for Very High Bit Rates  
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**Palavras Chave:** Receptores Ópticos, Sistemas Ópticos, Solitões Ópticos, Processamento de Sinal  
**Key Words:** Optical Receivers, Optical Systems, Optical Solitons, Signal Processing  
**Doutoramento/Ph.D.**

**Resumo**

O trabalho apresentado na tese é dedicado ao desenvolvimento, optimização e realização de receptores com pré-amplificação óptica, apropriados para sistemas de telecomunicações de elevada capacidade.

São investigados filtros de pós-deteccção destinados a sistemas de recepção para sinais com o formato de retorno a zero (RZ), considerando a minimização dos diversos factores que degradam o desempenho destes sistemas.

São propostas e comparadas analiticamente e experimentalmente diferentes estruturas de filtros de pós-deteccção, desenvolvidas para sistemas de recepção de dados RZ a 10 Gbit/s e a 15 Gbit/s, tendo em conta o desempenho, a possibilidade de sintonia e a adaptação com os restantes subsistemas. O desempenho obtido com os filtros de pós-deteccção, desenvolvidos para 10 Gbit/s, são também comparados num sistema experimental de transmissão por solitão constituído por 200 km de fibra monomodo normal.

**Abstract**

This thesis is concerned with design, optimisation and realisation of optical preamplified receivers appropriate for high capacity optical telecommunication systems. A range of post-detection filters appropriate for multigigabit return-to-zero (RZ) signalling, taking into account different system impairments inherent in high speed optical communication systems were investigated. It is assessed the performance and the feasibility of a range of practical realisations using hybrid and monolithic technology for 10 Gbit/s and 15 Gbit/s. Appropriate filter structures providing active impedance match and electrical adjustable transfer function to be used in adaptive receivers were study and designed. The performances of the designed post-detection filters for 10 Gbit/s are evaluated and compared in an experimental optical system based on soliton transmission with 200 km of standard single mode fibre (SMF). Electrical equalisers suitable for non-return to zero optical communications systems, based on dispersion supported transmission (DST) technique, were also investigated. It was designed a DST filter prototype in GaAs monolithic technology for 20 Gbit/s optical systems. The designed filter has the main advantage of being electrically adjustable, in order to provide optical system tolerance to different operating conditions and fibre lengths. It has also the advantages of providing a good input and output impedance match in a broadband frequency range and a small size. The filter was successfully tested in 20 Gbit/s DST systems with transmission distances of 40 Km and 53 Km. The achieved product bitrate x distances are well beyond the limit due to the chromatic dispersion.

Clock recovery units appropriate for 10 Gbit/s and 20 Gbit/s optical receivers were also investigated, build and characterised. The designed units are based on open loop structures that includes a non-linear circuit, a very high Q filter and a narrow band amplifier. Particular emphasis has been put on the investigation of suitable structures in order to guarantee easy reproducibility, manufacturing and good performance, over a wide range of operating conditions, to make these units suitable for practical systems. The experimental characterisations of the developed prototypes show the ability to recovery the clock signal from the received data signal, with very low jitter and good tolerance to different operating temperatures and bit rate deviations.