

Experimental Study of Burst-Mode Reception in a 1300 km Deployed Fiber Link

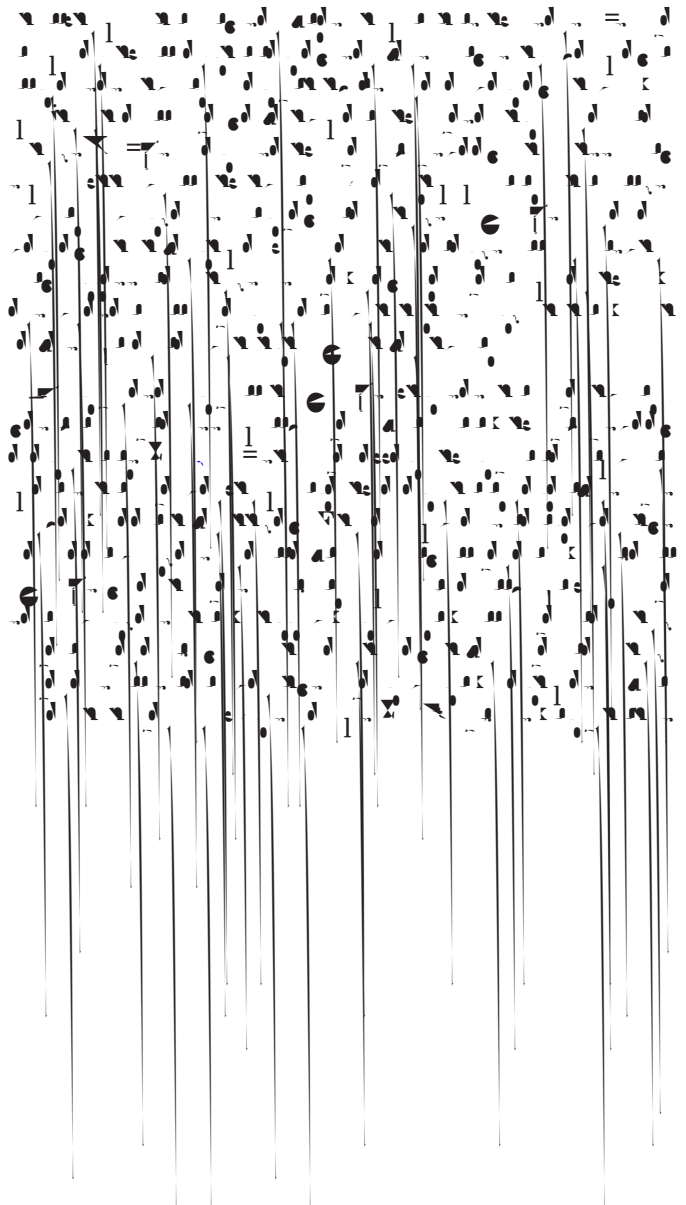
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Abstract—We experimentally demonstrate burst-mode reception in a 1300 km fiber link that spans from Montreal to Quebec City and back, with a 1.25 Gb/s burst-mode receiver (BMRx). The receiver features automatic phase acquisition using a clock phase aligner (CPA) and provides instantaneous (0 preamble bit) phase acquisition with error-free operation [packet-loss ratio (PLR) $<10^{-6}$ and bit error rate (BER) $<10^{-10}$] for an phase step ($\pm 2\pi$ rad) between consecutive packets, while also supporting more than 1100 consecutive identical digits (CIDs). The CPA makes use of a phase picking algorithm and an oversampling semi-blind clock and data recovery circuit operated at $2\times$ the bit rate. We also study the effect of channel impairments on the performance of BMRx at such distances. More specifically, we investigate the PLR performance of the system and quantify it as a function of the phase step between consecutive packets, received signal power, CID immunity, and BER, while assessing the trade-offs in preamble length, power penalty, and pattern correlator error resistance.

Index Terms—Burst-mode receiver; Clock and data recovery (CDR); Clock phase aligner (CPA); Optical fiber communications; Optical networks.

I. INTRODUCTION

Long-haul optical fiber links are becoming increasingly important for data centers and cloud services. The deployment of 1300 km fiber links between Montreal and Quebec City and back has been a significant milestone. This paper presents the experimental study of burst-mode reception in such a long-haul fiber link. The burst-mode receiver (BMRx) is designed to support high data rates (up to 1.25 Gb/s) and to provide instantaneous phase acquisition (0 preamble bit) with error-free operation. The BMRx features a clock phase aligner (CPA) and an oversampling semi-blind clock and data recovery circuit. The CPA uses a phase picking algorithm and an oversampling semi-blind clock and data recovery circuit operated at $2\times$ the bit rate. We study the effect of channel impairments on the performance of BMRx at such distances. More specifically, we investigate the PLR performance of the system and quantify it as a function of the phase step between consecutive packets, received signal power, CID immunity, and BER, while assessing the trade-offs in preamble length, power penalty, and pattern correlator error resistance.



This section of the musical score is highly dense, featuring approximately 15 vertical staves. Each staff is filled with a complex arrangement of musical notation, including numerous notes, stems, and beams. The notation is oriented vertically, with the staves themselves running from top to bottom. The notes are small black dots, and the stems are thin vertical lines. There are some red markings on the left side of the first few staves, possibly indicating specific notes or measures. The overall appearance is that of a very intricate and detailed musical composition.

This section of the musical score is much sparser than the first section. It consists of a few horizontal staves, with only a few notes and stems visible. The notation is oriented horizontally, with the staves running from left to right. The notes are small black dots, and the stems are thin horizontal lines. There are some red markings on the left side of the first few staves, possibly indicating specific notes or measures. The overall appearance is that of a very simple and minimalist musical composition.

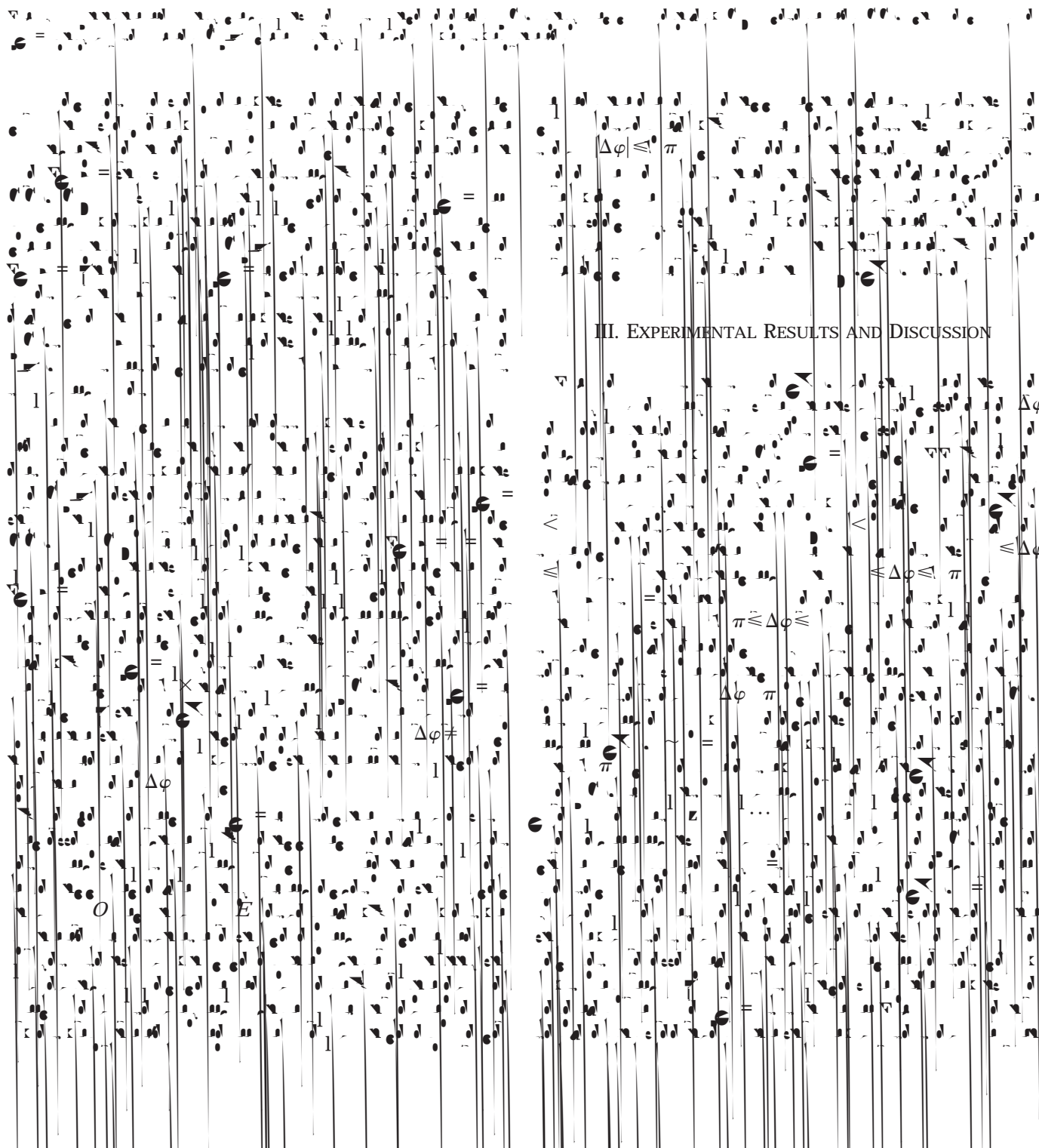
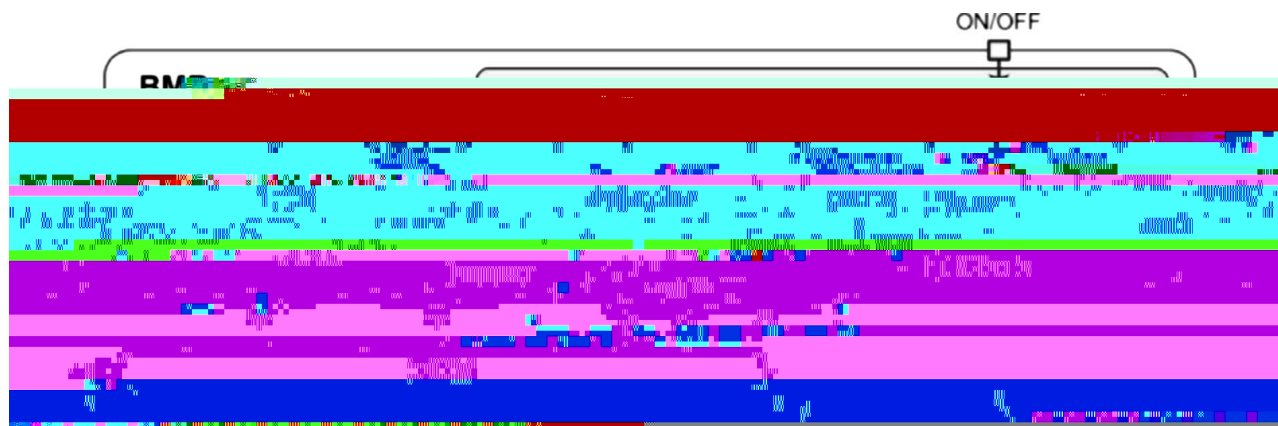
$\Delta \phi$ ϕ φ

$\Delta \pi$

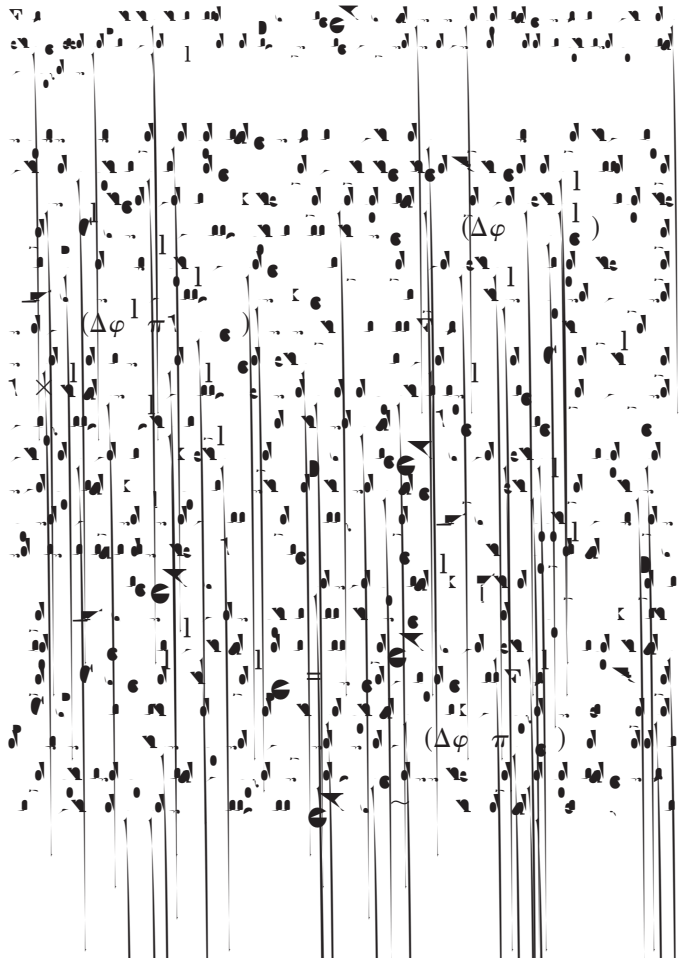
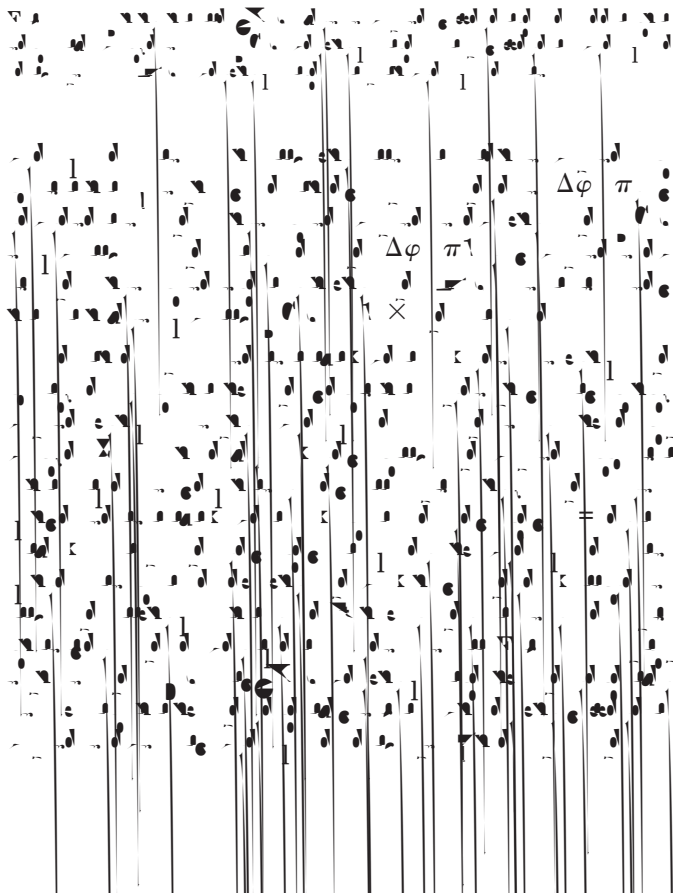
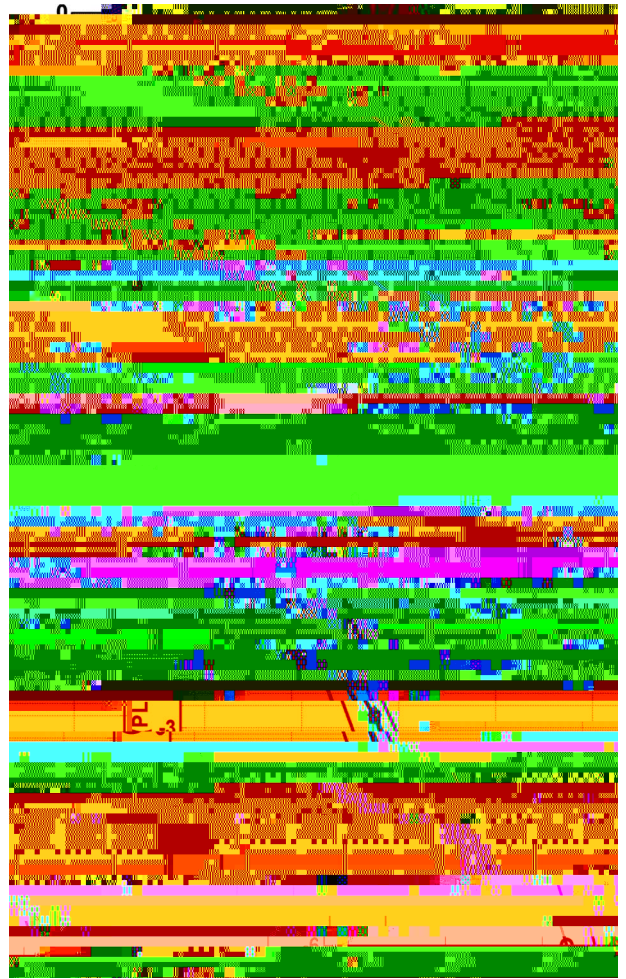
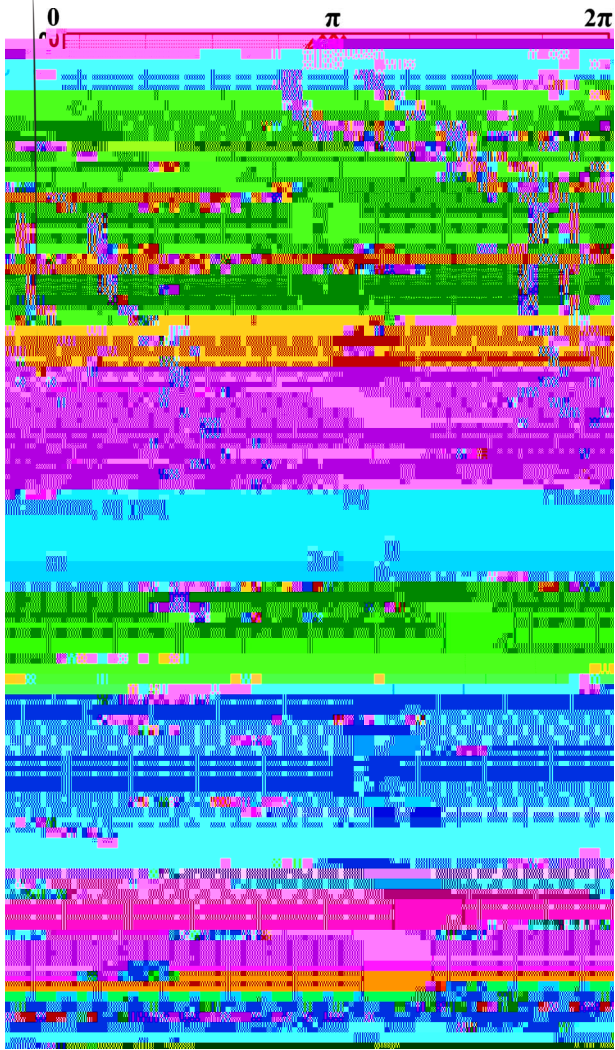
$\Delta \phi$ m T_s

$T_s \left(m; \frac{\Delta \phi}{T} \right) T$ ()

T



III. EXPERIMENTAL RESULTS AND DISCUSSION



This image displays a complex musical score oriented vertically. It features approximately 12 staves, each containing a series of notes and stems. The notes are small black circles, and the stems are thin vertical lines extending downwards from the notes. The score is densely packed, with many notes appearing on each staff. A single red dot is visible on the fourth staff from the top, marking a specific point in the music. The overall appearance is that of a highly detailed and intricate musical composition.

This image shows a complex musical score, likely for a large ensemble or orchestra. The score is written on multiple staves, with a dense arrangement of notes, rests, and other musical symbols. The notation is highly detailed, featuring many small notes and rests, suggesting a fast or intricate piece of music. The score is presented in a vertical orientation, with the staves running from left to right. The overall appearance is that of a highly technical and detailed musical manuscript.

P_i *P_e*



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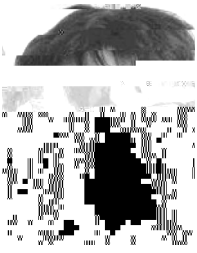
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