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PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA ELÉTRICA – PPGEE
UNIVERSIDADE FEDERAL DE SÃO CARLOS - UFSCar

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<u>ARTIGO 1:</u> *A Qualitative Analysis of a USB Camera for AGV Control*

LINK: https://doi.org/10.3390/s19194111

Abstract

The increasing use of Automated Guided Vehicles (AGV) in the industry points to a search for better techniques and technologies to adapt to market requirements. Proper position control and movement give an AGV greater movement accuracy and greater lateral oscillations stability and vibration. It leads to smaller corridors and leaner plants, to more relaxed shipment devices, and to greater safety in the transport of fragile loads, for instance. AGV control techniques are not new, but new sensors' applications are possible, such as USB cameras. In this sense, it is necessary to ensure the sensor is adequate to control system requirements. This work addresses AGVs driven by passive floor demarcations. It presents a qualitative analysis of a USB camera as sensors for AGV control, not yet a common industrial application. We performed the experiments with a small AGV prototype on an eight-shaped lane, varying both camera parameters and AGV parameters, such as linear speed. The AGV uses a USB camera with different image processing settings—different morphological filters structuring elements shapes and sizes, and three different image resolutions—to analyze the factors that affect line detection and control processing. This paper's main contribution is a qualitative and quantitative analysis for the different sensor configurations. In addition, it discusses the influence sources on camera image as a position sensor. Furthermore, the experiments confirm sensor pertinence for the proposed control system.

ARTIGO 2: *Optofluidic refractive-index sensors employing bent waveguide structures for low-cost, rapid chemical and biomedical sensing*
LINK: https://doi.org/10.1364/OE.26.000273

Parte 1:

Abstract

We propose and develop an intensity-detection-based refractive-index (RI) sensor for low-cost, rapid RI sensing. The sensor is composed of a polymer bent ridge waveguide (BRWG) structure on a low-cost glass substrate and is integrated with a microfluidic channel. Different-RI solutions flowing through the BRWG sensing region induce output optical power variations caused by optical bend losses, enabling simple and real-time RI detection. Additionally, the sensors are fabricated using rapid and cost-effective vacuum-less processes, attaining the low cost and high throughput required for mass production. A good RI solution of 5.31 10^{-4} × RIU^{-1} is achieved from the RI experiments. This study demonstrates mass-producible and compact RI sensors for rapid and sensitive chemical analysis and biomedical sensing.

Parte 2:

Figure 4 illustrates the optical detection system for the fabricated WG RI sensors. A commercially available, low-cost, 532-nm green LED was used as the light source. Compared to lasers, LEDs feature superior power stability, which is crucial for intensity-detection-based RI sensing systems to achieve better RI resolutions [31]. To further enhance the signal-to-noise ratio, a lock-in technique was employed by driving and directly modulating the LED using a 1-kHz square wave with a 50% duty cycle by a homemade LED driver. The emitted light was collimated using a lens and then coupled to the facet of the tapered WG of the sensor chip via a 20× objective. The WG sensor chip was mounted on a three-axis translation stage to finely adjust the position of the chip to couple the incident light into the WG with minimal coupling losses. The transmitted light through the WG chip was filtered by an adjustable iris, focused by a lens, and then directed to a Si PD to convert the output light intensity into photocurrent. Subsequently, the generated photocurrent was amplified by a homemade current amplifier with a band-pass filter, followed by an analog-to-digital converter to transform the analog signals to digital signals. Finally, the digital signals were recorded in real-time by a computer and demodulated using a lock-in program. Without bulky and costly components, this detection system provides the unique advantages of compactness and low cost required for practical applications.

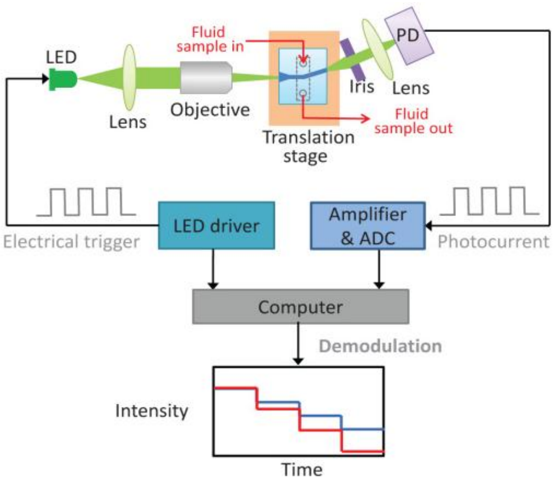

Fig. 4 Schematic of the transmission measurement system for the fabricated optofluidic waveguide refractive-index sensors.
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ARTIGO 3: *Active power quality management in smart microgrids*
LINK: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9582875

Parte 1

1 Introduction

Due to the increasing penetration of converter-connected energy resources, consumer electronics, and on the other hand increase in, awareness of the public on power quality issues, penetration of power quality sensitive loads, smart metering devices, etc., power quality is becoming an issue of high importance for utilities and consumers. The levels of power quality required on different nodes (or zones) of the network are not the same, e.g. critical loads such as data centres, hospitals, communication systems require a high level of power quality that includes high availability, and low-distortion voltage and current [1, 2]. However, the power network can be susceptible to natural disasters such as hurricanes, earthquakes, and storms and the power network should be prepared for these events in advance to avoid any serious problems. Today, power quality delivered to customer points of connection is managed by static regulatory and planning rules that relate to voltage delivery limits, harmonic content limits, and supply availability. This means power quality delivered is within a tolerance threshold, often above or below the required service levels of different customers [3–5]. This standardisation has been historically important for planning methodologies that assume passive network operation and for the most sensitive customer loads. As the penetration of power electronic devices and non-linear loads is increasing in the power grid, these issues have an increasing impact on the power systems. Customers with power quality requirements more stringent than network-wide standards have been required to self-manage through the use of local site-specific PQ improvement devices. It highlights the importance of having different levels of power quality for different zones to survive extreme conditions or to flexibly satisfy the power quality requirements of different customers. Contrary to some power network issues that emerge from higher levels of the power system, power quality issues usually start from the distribution network level, which again makes the importance of distribution level power quality management clear. Power electronic based devices can support the power quality of the grid by locally compensating for the harmonics using active and passive power filters, voltage sag and swells using uninterruptible power supply, automatic voltage regulator, dynamic voltage restorers, reactive power compensation [static synchronous compensators (STATCOMs)], and similar issues [1, 6, 7]. Although this method of power quality improvement has been working until now, due to changes in the consumer load from both sensitivity and power quality pollution aspects, it will not be as effective as it was before. Furthermore, other than the financial aspect of power quality improvement devices (PQID) installation, since most of the PQIDs are power electronic based, which may create other issues in power system stability and protection, adding single devices to improve the zonal power quality does not seem to be the best solution [8]. Instead, using the recent technologies to have active management on power quality improving and deteriorating devices would be an alternative to adding more power electronic-based devices to the power system. The concept of smart grids makes it easier to introduce flexibility, resilience, improved power quality and the integration of renewable energy sources (RESs) to the traditional power systems altogether. These objectives could be achieved by the means of modern metering and monitoring devices, fast and accurate communication systems, novel control methods for power electronic-based RESs and distributed or central management systems [9]. Several solutions for this issue are presented in this paper including novel ideas on power quality management. These solutions include distributed, optimised installation of active or passive PQIDs based on the fundamental and harmonic power flow analysis [10], using different control methods to improve the quality of the output/input power in power electronic converters [11–15], getting ancillary services from power electronic-based distributed generation units to operate as PQIDs and to actively control and manage high-penetration non-linear loads such as electric vehicle supply equipment (EVSE) and heat pumps (HPs) which is described in details in Section 3.

2 Concept definition

Fig. 1 represents the power grid today, where a mixture of different types of loads and consumers have different power quality requirements that are supplied with power of same power supply and therefore experience the same power quality level. As the

Parte 2

Starting from the distribution level, a coordinated control method could be applied to high-penetration non-linear loads such as EVSEs or HPs. This coordinated control, unlike the previously proposed smart charge management methods for EVSEs that have concentrated on voltage and demand management [16], takes into account the power quality limitations when controlling the mentioned units. A high-level explanation of the coordinated control of EVSEs could be seen in Fig. 2. The active power quality management (APQM) concept, shown in Fig. 3, combines a number of planning and management tools to supply different levels of power quality to different customers, with minimum cost and maximum reliability. At the device level, there are a couple of solutions to maintain the required power quality, for example, to minimise the output/input distortion of the power electronic-based devices, new control methods are applied to novel converter topologies. Passive filters are one of the cheapest PQIDs, but may not be as effective as they could be if used in isolation. A combination of passive, active, and hybrid filters will help to suppress the harmonics and will locally compensate for the distortions. Recently, the idea of utilising the distributed energy resources (DERs) converters for ancillary services has been introduced and deployed to support the power system by locally compensating for the harmonics [17].

With the falling cost of Information and Communication Technologies and the proliferation of measurement and control capabilities, power quality planning and operation paradigms should be revisited to ensure they are optimal for the demands of today's grid. Not only are new power quality improvement solutions available, i.e. smart impedances, electrical springs or multifunctional distributed generation units [18, 19] but through measurement and control, a variable and actively controlled level of power quality could be dispatched to meet the specific needs of customers in a network zone. In a world of increasing converter connected loads and DERs, there is doubt that if it is cost-effective to actively monitor and manage power quality compared to passive operation managed through device regulations and planning level thresholds. So, APQM using planning and management tools to coordinate highly distorted loads, such as electric vehicle (EV) charge points and HPs, could ensure that the power quality levels of distinct zones are maintained within the defined limits.

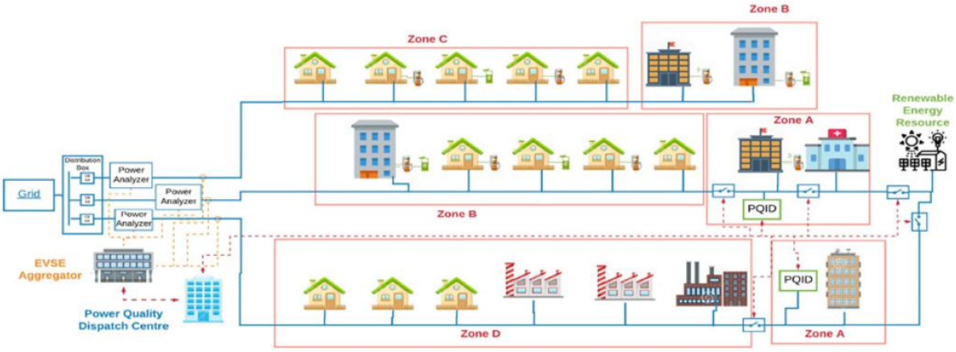

Fig. 3 . *Sample power system with APQM concept applied*