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A new solution for machining with RA-PKMs: Modelling, control and experiments

Jonatan Martín Escorcia-Hernández, Ahmed Chemori, Hipolito Aguilar-Sierra, Arturo Jesús Monroy-Anieva

A New Solution for Machining with RA-PKMs: Modelling, Control and Experiments

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Abstract

In this paper, a novel 5-Degree of Freedom (DOF) Redundantly Actuated (RA) Parallel Kinematic Manipulator (PKM) called SPIDER4 is presented. The main purpose of this manipulator is to perform machining tasks such as drilling and milling. All the mathematical models including the forward and inverse kinematic models, as well as the inverse dynamic model were developed. Owing to machining tasks require high precision, a RISE Feedforward controller is proposed for desired trajectory tracking. To show the performance and effectiveness of the proposed control scheme, real-time experiments were performed. The obtained results of the proposed controller compared to the standard RISE controller are presented and discussed. They confirm that the proposed controller outperforms the standard one.

Keywords: Parallel Kinematic Manipulators, Kinematic Models, Dynamic Model, RISE Control, Actuation Redundancy

1. Introduction

Parallel Kinematic Manipulators, also called in the literature Parallel Kinematic Machines or Parallel Robots belong to a specific kind of manipulators formed by a fixed base connected to a mobile platform via several independent kinematic chains. These manipulators have been used in various areas ranging from medical applications to industrial applications. The main industrial applications developed by PKMs include among others flight simulators, food packaging and machining manipulators [1]. Machining is the broad term used to describe the removal of material from a workpiece and is one of the most important manufacturing processes. Machining operations can be applied to metallic and non-metallic materials such as polymers, wood, ceramics, composites and other materials. The most common machining operations are milling, turning and drilling, these operations require a high precision in positioning of the cutting tool as well as in the desired cutting path, hence the machine tools should satisfy these requirements [2]. The inclusion of the Computer Numerical Control (CNC) in machine tools has allowed this industry to obtain high quality products, with a shorter production time and a lower cost, compared to the first manually operated machine tool [3]. Conventional machine tools have mainly serial kinematic architecture

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IMPACTO FISCAL PARA LA CORRECTA APLICACIÓN DE LAS FACILIDADES DE COMPROBACIÓN

María del Rosario López Torres[1], Carolina Aguilar Montiel[2], Fabiola Aguilar Montiel[3] y César Ángel López Torres[4]

***Resumen*—. Las correctas aplicaciones de las facilidades de comprobación son de suma importancia para todos los contribuyentes, las cuales se publican mediante resolución miscelánea, cada año a través del Diario Oficial de la Federación (DOF). En éste artículo se presentan los resultados de una investigación cuyo objetivo es que las personas físicas de transporte estén enteradas de las facilidades de comprobación a que tienen derecho, las cuales disminuirán considerablemente su carga tributaria, ya que al tener conocimiento de que existen dichas comprobaciones fiscales aplicables al sector de autotransporte de carga federal, las podrán aplicar, de tal forma que traerá beneficio a dichos contribuyentes. Para el desarrollo de este trabajo se tomó una muestra de personas físicas pertenecientes al municipio de Tulancingo de Bravo, Hidalgo. Se pudo comprobar que muchos saben que existen facilidades de comprobación aplicables al sector de autotransporte de carga federal pero solo algunos las aplican, otros, aunque saben de su existencia no las aplican y otros no sabían que existían.**

***Palabras clave*—Auto transportista, Facilidades de comprobación, Carga Tributaria.**

Introducción

Actualmente las personas físicas y morales deben ser conscientes de la relevancia que tiene el contar con los comprobantes fiscales que les permita disminuir los impuestos y así obtener un beneficio fiscal, es importante que lleven un control acerca de todos los Comprobantes Fiscales Digitales (CFDI) que emiten y que se les emitan, con esto, se facilitará el cálculo oportuno de sus impuestos, beneficiado al contribuyente para que no deje de considerar ningún comprobante ya que sin información financiera no hay toma de decisiones asertivas, no habrá organizaciones competitivas y eficientes ya que si lo anterior ocurre, el contribuyente se vería perjudicado ya que aumentaría su carga tributaria (Granado, Ibarra & Amador, 2004). Asociado a esto, para los efectos de la Ley del ISR, los contribuyentes personas físicas y morales, que se dediquen exclusivamente al autotransporte terrestre de carga federal tendrán la opción de añadir a sus deducciones ciertos gastos que se encuentran dentro de las facilidades de administración que otorga el SAT, lo que le facilitará el cumplimiento de su carga tributaria, ya que al aplicar dichas facilidades el pago disminuirá (DOF, 2018).

Con base a lo anterior la Resolución de Facilidades Administrativas 2018 en su Regla 2.2 trata de facilitar la aplicación de algunos gastos que son complejos en materia fiscal, como es el servicio de las talachas y otros pagos que se hacen en carretera, que son necesarios para poder realizar su actividad. En lo que se refiere al autotransporte federal de carga existe una deducción opcional de deducir el 8% sobre el total de los ingresos del período sin que exista un CFDI, es decir se podrán deducir comprobantes simplificados y se estará obligado a enterar una retención de ISR del 16% (Luna, 2018); es decir, por los pagos que se realizan a trabajadores se podrá enterar el 7.5% por este concepto en lugar de aplicar las disposiciones que fija la ley; correspondiente a los pagos efectivamente realizados a operadores, macheteros y maniobristas; se tomará como base para el cálculo de estas retenciones el salario base de cotización que sirva para el cálculo de las aportaciones de dichos trabajadores al IMSS, y un registro de todos los pagos realizados con nombre e importe que se les pago a los trabajadores eventuales. De igual manera existe la facilidad de comprobación de hacer deducible el combustible por el cual no se utilice ningún medio de pago del sistema financiero, es decir el pagado en efectivo hasta por un 15% del total que se consuma en un periodo.

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Optothermal generation, trapping, and manipulation of microbubbles

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Abstract: The most common approach to optically generate and manipulate bubbles in liquids involves temperature gradients induced by CW lasers. In this work, we present a method to accomplish both the generation of microbubbles and their 3D manipulation in ethanol through optothermal forces. These forces are triggered by light absorption from a nanosecond pulsed laser ($\lambda = 532$ nm) at silver nanoparticles photodeposited at the distal end of a multimode optical fiber. Light absorbed from each laser pulse quickly heats up the silver-ethanol interface beyond the ethanol critical-point (~ 243 °C) before the heat diffuses through the liquid. Therefore, the liquid achieves a metastable state and owing to spontaneous nucleation converted to a vapor bubble attached to the optical fiber. The bubble grows with semi-spherical shape producing a counterjet in the final stage of the collapse. This jet reaches the hot nanoparticles vaporizing almost immediately and ejecting a microbubble. This microbubble-generation mechanism takes place with every laser pulse (10 kHz repetition rate) leading to the generation of a microbubbles stream. The microbubbles' velocities decrease as they move away from the optical fiber and eventually coalesce forming a larger bubble. The larger bubble is attracted to the optical fiber by the Marangoni force once it reaches a critical size while being continuously fed with each bubble of the microbubbles stream. The balance of the optothermal forces owing to the laser-pulse drives the 3D manipulation of the main bubble. A complete characterization of the trapping conditions is provided in this paper.

1. Introduction

Bubbles play a key role in fields such as thermodynamics [1,2], microfluidics [3–5], biomedical [6,7], hydraulics [8,9] but is also relevant in applications such as valves [10,11], motors [8,12], needle-free injectors [7], optical trapping and sorting [11,13–15] among others. These applications require extreme spatial control of bubbles' position to accomplish their purposes; however, this is quite difficult to achieve because many dynamic processes are involved. A great deal of both experimental and theoretical works have been carried out to fully understand the dynamics of the bubbles allowing their 2D manipulation based on acoustic, thermal, and optical phenomena [16–20]. The combination of these last two, also called optothermal effect, has shown to have several advantages at the microscale regime [21,22]. On one hand, optical phenomena provide both noncontact and noninvasive approaches of bubbles manipulation while thermal phenomena can provide forces many orders of magnitude larger than optical ones [16,19,23]. So optothermal phenomena offers the best of the two worlds.

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Choice of Jacobi–Fourier phase masks for wavefront coding under different *f*-number

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Wavefront coding (WFC) is an optical-digital technique that consists in introducing a suitable phase mask (PM) in the aperture plane able to extent, after image processing, the depth of field of an optical system. The key to WFC lies in the shape of the PMs to achieve the invariant imaging properties over the range of defocus. Cubic PM was the first proposed. Next, trefoil mask avoided periodic artifacts in the images keeping the goal of depth extension. The performance of the masks, resolution and noise of the coded images, depends on their strength, required range of defocus and *f*-number of the optical system. Here, we will provide the experiments that will support that a member of the Jacobi–Fourier phase masks can be chosen depending on the *f*-number of the optical system to get the best balance between resolution, noise level and artifact presences while keeping depth of focus.

1. Introduction

Optical imaging with a large depth of focus (DoF) is a longstanding goal with important applications in many fields. The traditional way to extend the DoF is to stop down the aperture until the desired focal depth has been reached. Three problems, however, quickly arise from stopping down exit pupils. The first problem is the obvious reduction in the amount of light power allowed through the system. Reducing x times the exit pupil diameter of any system will require that x^2 times more power or exposure time be used in the system before an image of equal exposure is produced.[1)] The second problem is that stopping down the aperture reduces the resolution of the system. The third one is that stopping down the aperture will also increase the risk of object motion during an increased exposure time, resulting in a blurred image.[2,3)] To overcome these limitations, wavefront coding (WFC) can deliver systems that operate with large apertures but offer the DoF of a reduced aperture system.

Dowski and Cathey developed a technique called WFC which involves a combination of a cubic phase mask (PM) at the aperture stop of the system and digital signal processing techniques to extend the DoF of an incoherent optical system without sacrificing resolution or illumination.[4–6)] WFC can increase the DoF of an optical system by a factor of ten or more compared to traditional imaging systems, for a given aperture size or equivalently a given *f*-number, *f*/#.[6–8)]

WFC can be found in many different applications such as infrared imaging,[9)] ophthalmic optics,[10)] iris recognition,[11,12)] microscopy,[13)] among others as well as to reduce complexity of optical systems.[14)]

WFC involves a cubic phase or other special PM at the exit pupil plane of a system. The PM modifies the imaging system in such a way that the resulting point-spread function (PSF) and optical transfer function (OTF) of the optical systems are insensitive to defocus, yielding a blurred image nearly invariant to defocus. Digital signal processing techniques removes the blur to create a clear image.[14–17)]

When designing PM for WFC systems, two properties have to be taken into account. The PSF of the system should corresponding modulation transfer function (MTF) should not exhibits zeros for the needed frequency range. The absence of zeros in the MTF is what enables a high-fidelity image to be recovered by the digital inversion.[4–9)] Moreover, the optical and digital components have to be jointly designed to an end, while traditional imaging systems, the design of the optics and the processing of the recorded images are two separate steps.[14,15,18)]

The shape of the mask plays a key role of a good performance within the desired DoF. Many shapes deriving from the original cubic PM solution have been proposed for WFC showing slight improvements. The most representative of these are: root square,[19)] sinusoidal,[20)] free form,[21)] exponential,[22)] tangential,[23)] among many other. Trefoil PM was proposed to avoid diagonal banding[24)] in the decoded images induced by the above-mentioned masks, but yet edge artifacts remain.[25)]

Best choice of the PM is one of the key tasks in the design of WFC based systems. Recently we have proposed a family of Jacobi–Fourier phase masks (JFPM),[26)] showing that some of them may provide a quality improvement in what resolution, artifact reduction and sensitivity to noise refers.[26–28)] A thorough description of the optical properties of these special phase plates can be found in Refs. 26–28. The theoretical results in Ref. 26 are supported by the experiments of this work, confirming that JFPM are a good alternative to trefoil PM in some WFC systems. More specifically, we will show that the choice depends on the *f*/# of the optical system and strength of the mask for same extension of the DoF and exposure time. This paper is organized as follows. A brief description of the masks and the algorithms for the image processing are shown in Sect. 2. In Sect. 3, the experimental set up as well as the experimental results and the discussion of them are provided. Conclusions are given in the last section.

2. Image processing

JFPM have been recently proposed in order to reduce oscillations of the defocused MTF and the phase transfer function[26)] what can be associated with the edge artifacts[19,25)]

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Comparison of melanin content of tiny moles versus normal skin sites using diffuse reflectance spectroscopy

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ABSTRACT

Diffuse reflectance spectroscopy (DRS) has been widely used to interrogate the metabolic state and structure of several biological tissues with diagnostic purposes. The aim of this research is to compare the melanin content (melanosome volume fraction) of normal non-pigmented human skin sites versus skin sites containing tiny moles ranging from 1.2 mm to 2 mm diameter. The study was carried out in a group of ten volunteers presenting five different skin phototypes (I-V). Diffuse reflectance spectra of these sites were acquired with a USB 4000 fiber optic spectrometer and homemade optical probe consisting of two optical fibers separated 2.5 mm. In order to extract optical properties of skin sites containing tiny moles, a relative simple but novel skin model was proposed and used in combination with a slightly modified version of the inversion algorithm *analyze2.m* which is freely available. We found that melanin content ranges from 3.3 % to 29.2 % for the normal skin sites surrounding pigmented skin sites, while for skin sites with tiny moles melanin content varies from 7.6 % to 78.4 %. Our finding shows that for each volunteer the melanin content of pigmented areas is twice or more the melanin content of non-pigmented normal skin areas. In addition, we have evaluated the sensibility of the inverse extraction algorithm when the melanin content is varied while the remaining "guess parameters" (S, B, a, const) are kept constant. We have found that all the remaining parameters are strongly affected when the melanin content is changed.

Keywords: spectroscopy, melanin content, normal skin, tiny moles, diffuse reflectance spectroscopy

1. INTRODUCTION

The implementation of inexpensive and non-invasive optical techniques for the diagnosis and treatment of various pathologies is an urgent task. One of the most established tools in this field is Diffuse Reflection Spectroscopy (DRS) which has been widely used to investigate the metabolic status and structure of different types of biological tissues for diagnostic purposes. One of the simplest ways to implement it is to place a probe made up of two optical fibers, one of which is responsible for emitting light onto the tissue, for example the skin, and once the light interaction process with the biological tissue occurs, the other fiber is responsible for collecting the diffusely reflected light. Subsequently, from the spectra measured by an optical spectrometer, and making use of an analytical mathematical model and computational tools, it is possible to calculate the physiological properties of healthy and injured skin.

The optical properties of the human skin (absorption and reduced scattering coefficients) and its physiological properties, have been reported by several authors [1-7, 9-15], who use the diffusion approximation theory or the Monte Carlo method, as the analytical models for their study. These optical properties are closely related to the physiological properties of the skin, such as: the volume fraction of melanosomes (Mel), the blood volume fraction (B), the water content (W), the oxygen saturation (S); and the scale the skin scattering (a). All or some of these physiological parameters of healthy skin have been published by the aforementioned authors, with the exception of Boone *et al.* (2015) [7] who only studied the nevi and melanomas in individuals with skin phototypes I and III, according to the Fitzpatrick classification scale. It is known that this scale classifies the skin considering its response to solar radiation and the phenotypes or genetic characteristics of different ethnic groups (hair, eye, and skin color), with six different types (phototypes from I to VI) as reported by Fitzpatrick in 1988 [8]. On the other hand, we have found in the bibliographic review of this topic that the physiological properties of the skin have been reported of both healthy and injured skin of the volunteers who participated in the study [3, 6, 11, 12, 13]. In two of these research works, the authors used the

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Estrategias de mediación tecnopedagógicas en los ambientes virtuales de aprendizaje

Technopedagogical mediation strategies in virtual learning environments

Moramay Ramírez Hernández* | Elizabeth Cortés Palma** | Angelina Díaz Alva***

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RESUMEN

Este artículo presenta los resultados de una investigación sobre la importancia de establecer estrategias de mediación tecnopedagógicas cuando se implementa un ambiente virtual de aprendizaje (AVA). El objetivo es mejorar la eficiencia de una plataforma de tutoría virtual en el proceso de enseñanza-aprendizaje mediante estrategias aplicadas al modelo de tutoría virtual de una universidad tecnológica. La metodología se basó en un enfoque mixto: la parte cualitativa se trabajó con un grupo focal y la cuantitativa, con un muestreo por conglomerados. La principal aportación de este trabajo son las seis categorías y estrategias propuestas, que pueden utilizarse en cualquier AVA. Los resultados confirman la importancia de guiar al estudiante, establecer mecanismos de comunicación, interacción y aplicación de las metodologías de aprendizaje, así como su relación con las tecnologías de la información y la comunicación. La única limitante hasta el momento es que se requiere un servidor dedicado, y ancho de banda de calidad para mejorar el servicio.

Abstract

This paper describes the research done about the importance of establishing technopedagogical mediation strategies when a Virtual Learning Environment (VLE) is implemented. The objective of this work is to improve the efficiency of the Virtual Tutoring Platform in the teaching-learning process, through the implementation of strategies in the virtual tutoring model of a technological university. The methodological part of the work was developed using a mixed approach: the qualitative part was worked with a focus group and the quantitative part was carried out with cluster sampling. The main contribution of this work is the six categories and strategies proposed, which can be applied to any VLE. The results confirm the importance of guiding the student, establishing communication mechanisms, interaction and application of learning methodologies as well as their relationship with the information communication and technologies. The only limitation so far is that a dedicated server and good bandwidth are required to improve the service.

Palabras clave
Tecnología educativa; ambiente virtual de aprendizaje; mediación tecnopedagógica; plataforma de tutoría virtual; TIC

Keywords
Educational technology; virtual learning environment; technopedagogical mediation; virtual tutoring platform; ICT

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TARJETA INFORMATIVA

PARA	**Dr. Alfonso Padilla Vivanco** Secretario Académico de la UPT
DE	**Dr. José Humberto Arroyo Núñez** Director de Investigación y Posgrado
ASUNTO	**Conclusión de Proyecto**
FECHA	13 de noviembre 2020

Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

"Steady-State 3D Trapping and Manipulation of Microbubbles Using Thermocapillary"

El resultado de este trabajo, ha sido publicado en una revista de alto impacto

Se anexa al presente documento la evidencia de la publicación

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ATENTAMENTE

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Steady-State 3D Trapping and Manipulation of Microbubbles Using Thermocapillary

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An experimental and theoretical study on the 3D trapping and manipulation of microbubbles by means low power laser-induced temperature gradients induced in ethanol by bulk light absorption (λ = 1550 nm) is presented. Two optical fibers were used: One for bubble generation (OF_G) and the other for both trapping and manipulation (OF_T). Light from a Q-switched pulsed laser (λ = 532 nm and pulse width τ_p = 5 ns) propagates in fiber OF_G and gets absorbed at silver nanoparticles (AgNPs), previously photodeposited, at the distal end of a fiber optic core, generating the microbubbles. In the fiber OF_T, light of low power CW laser was used to trap and manipulate the bubbles by thermocapillary induced by light bulk absorption in ethanol. The microbubble generated on OF_G migrates toward the fiber OF_T. The equilibrium between the buoyancy force F_B, drag force F_D and the Marangoni force (also known as thermocapillary force) F_M gives rise to a 3D stably trapping and manipulation of the microbubble for the best time to our best knowledge.

Keywords: trapping, manipulation, microbubble, thermocapillary, Marangoni force

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INTRODUCTION

Trapping and manipulation of microbubbles have become a very useful tool in various applications such as manipulation of micro-objects [1, 2], fabrication of micro-valves [3, 4], photolithography [5], among others. There are different techniques for generating, trapping, and manipulating microbubbles in liquids using thermal [6–8], acoustic [9, 10], and optical effects [11–13]. Thermal effects have been considered as an unwanted side effect on optical trapping; however, forces of thermal origin are orders of magnitude greater than optical ones, thus offering plenty of opportunities for the manipulation of micro-objects [1, 2]. In fact, generation and 2D trapping of microbubbles using light induced temperature gradient using absorbent thin films deposited on one of the substrates has been demonstrated for several authors [5, 14, 15]. Later, absorption in the bulk and from nano/microparticles suspended on the liquid were used to achieve thermal trapping and manipulation [8, 16, 17]. More recently, Benerjee et al. [18], reported the trapping and 2D manipulation of bubbles due themal bluming and Marangoni effect triggered by light absorption of a focused CW laser on colloidal particles suspended in isopropanol. However, they require rather large optical powers >100 mW; besides, they did neither show steady-state trapping nor stably manipulation. Recently, our research group has demonstrated both the generation and quasi-steady-state trapping and manipulation of single microbubbles in optical fibers using the Marangoni effect [19, 20].

TARJETA INFORMATIVA

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Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

"Modeling and Speed Tuning of a PMSM with Presence of Fissure Using Dragonfly Algorithm"

El resultado de este trabajo, ha sido publicado en una revista de alto impacto.

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Article

Modeling and Speed Tuning of a PMSM with Presence of Fissure Using Dragonfly Algorithm

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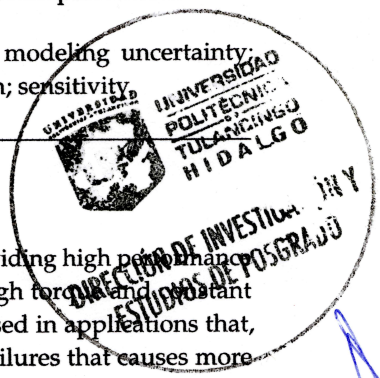
Abstract: This paper presents a robust trajectory tracking control for a Permanent Magnet Synchronous Motor (PMSM) with consideration a fault, parametric uncertainties and external disturbances by effectively integrating robust optimal linear quadratic control. One kind of fault is considered in the machine, particularly the presence of fissure rotor. The dynamic model of the PMSM with the presence of fissure presents highly non-linear behaviors, which means that tuning is quite complicated, which the tuning was chosen through swarm intelligence optimization (Dragonfly Algorithm). A sensitivity analysis is carried out, in order to limit the search range to minimize the evaluation time. This methodology was used to diminish these defects during motor operation. Simulation results show that the optimal linear quadratic control method has a robust fault-tolerant performance.

Keywords: modeling of the continuous system; parameter estimation; modeling uncertainty; computational optimization method; inertia degradation; fissure mechanism; sensitivity



1. Introduction

The Permanent Magnet Synchronous Motors (PMSM), in addition to providing high performance in applications where it is necessary to correct the power factor, provide high torque and constant speed under variable loads, which makes them increasingly studied and used in applications that, until a few years ago, were restricted to induction motors [1]. One of the failures that causes more interest, especially in electric motors of considerable sizes, is due to vibratory problems, caused by imbalance, which, in turn, are generated by degradation in the rotor shaft, that is, fatigue phenomena which, finally, causes fracture in the rotor shaft [2]. The behavior of the propagation of fissures in solid materials is a subject of great interest in the field of engineering, thereby helping to preserve the life of mechanical devices [3]. A contribution to the fault-monitoring approach and input–output feedback linearization control of the induction motor (IM) in the closed-loop drive is presented in [4]. Two kinds of faults are considered in the machine, particularly the broken rotor bars and stator inter-turn short circuit faults. Therefore, the neural network (NN) technique is applied in order to identify the faults and distinguish them. However, the NN requires a relevant database to achieve satisfactory results. Hence, the stator current analysis based on the HFFT combination of the Hilbert transform and fast Fourier transform is applied to extract the amplitude of the harmonics and used them as an input dataset for NN.

Rotor faults have drawn more attention from the Artificial Intelligent (AI) research community in terms of utilizing fault-specific characteristics in its feature engineering. In [5], a review and definition