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Analog-to-digital converter survey and analysis Using ARAS Method

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Abstract: The digital signal processor (DSP) facilitates various signal processing tasks such as filtering, pre-equalization, linear echo cancellation, remote signal balancing, and time recovery operations. This is achieved through high-pass filtering, which is an analog signal preconditioning technique. The DSP section enables these functions without requiring a separate amplifier, offering flexibility in design. Additionally, advancements in ADC architectures and integrated circuit technologies have expanded possibilities and overcome previous limitations in signal processing capabilities. A current trend involves the adoption of single-chip ATCs, which results in reduced power dissipation. Nevertheless, there are challenges in terms of ADC resolution (measured in bits) and the sampling rate. The process involves converting input voltages into digital code, which requires analog-to-digital conversion and referencing against two reference voltages before generating reference codes. The suggested ADC design integrates both analog and digital components, with the ADC itself operating within the digital domain. It receives input in the form of digital codes along with two reference signals, allowing it to accommodate variations in process, voltage, and temperature (PVT). The architecture comprises a combination of a signal module and a digital signal processing (DSP) module. Channel inputs are processed through switch-capacitor-based sample and hold circuits, which are then combined using addition or subtraction sequences. Notably, this combination method does not result in any bandwidth expansion. The discrete-time signals produced can either be directly from a single ADC (Analog-to-Digital Converter) or converted into digital sequences through scaling. Recurrent Neural Networks' abilities are contingent upon their dynamics, which in turn rely on their behavior. An analogous composite of this idea is pivotal in digital processing calculations. A non-linear electronic unit serves as the equivalent in analog processing. We adopt a rounded approach in both digital and analog processing within discrete time. To mitigate effects, 14 methods have been suggested by segmenting the process into blocks. The signal loss and amplified power during data exchange have been addressed by exploring the utilization of nanofibers within a condensed timeframe. This manufacturing technique proves highly adaptable, boasting small pore sizes and fiber diameters, resulting in increased surface area and controllable orientation. Another approach involves collagen micro-fibers, which self-assemble through a co-emission method. To tackle the issue of updating, Multiple Attribute Decision Making (MADM) methodologies have been employed. These methods effectively assess the status of current structures, offering equally optimal ratings and facilitating comparisons with alternatives, including those aligned with Nearly Zero Energy Building (NZEB) standards. This comparison fulfills the criteria for Nearly Zero Energy Building (NZEB) standards, enabling the choice of the most effective update strategies through the use of the Admission Ratio Assessment System (ARAS). It explores the cultivation of atrophy plants in new climatic regions of Iran for the purpose of biodiesel production, with a focus on selecting the most suitable province. The objective of this article is to evaluate the potential for cultivating atrophy plants in Iran, specifically addressing a gap noted in previous feasibility studies which did not account for environmental factors. In this study, the literature review identified selection criteria for extracting CWEs at specific cutter locations. Initially, compensation was applied to a physical entity, which then made cuts along the work piece. Subsequently, the resulting removal block was broken down into individual faces. Representation is showing the highest rank and Signal Integrity is showing the lowest rank.

Keywords: Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning.

1. INTRODUCTION

It seems like you're discussing a model that involves modifying cellular behavior based on analog parameters related to TNF- α -induced NF- κ B signaling. Here's a paraphrased version: The model incorporates analog parameters such as NF- κ B peak intensity, response time, and the number of oscillations, which subtly encode a set of instructions to modify cellular behavior in response to TNF- α -induced NF- κ B signaling. This model aims to be widely applicable, incorporating both digital measurements and analog dynamics, as well as capturing various exposure profiles. It utilizes mathematical stochastic modeling techniques to reproduce cellular responses accurately [1]. Utilizing the advantages of both digital and analog domains, a DSP processor can effectively integrate onto a chip in a manner conducive to streamlining signal preprocessing. This approach enhances the feasibility of real-time signal conditioning. The resulting DSP solution can operate without the need for amplifiers, thereby reducing die area and power consumption, as elaborated upon in the subsequent discussion on cost-effectiveness [2]. Analysis of Signal-to-Noise Ratio (SNR) on an octave basis reveals that a 1-bit change in slope occurs from sample to sample, indicating variability linked to what is termed aperture jitter or aperture uncertainty. This variability, referred to as character, is further influenced by the ambiguity inherent in sample speed comparators, particularly in their ability to accurately discern the relative amplitudes of input voltages [3]. This integration serves as a fundamental building block for Mersisters, facilitating the connection of transistors at a basic component level. Our methodology diverges from conventional mixed-signal design, emphasizing the segregation of analog and digital components. Despite their distinct nature, these components effectively communicate at the signaling level [4]. The total power dissipation of a successive approximation analog-to-digital converter (SS ADC) is predominantly influenced by its analog circuits. Therefore, efforts should be focused on minimizing power dissipation in these analog circuits. Utilizing Nano amp reference currents can effectively reduce power dissipation in analog circuits. However, it's crucial to note that variations in voltage, temperature, and process (PVT) can distort the overall performance of the SS ADC. Therefore, strategies to mitigate these variations should also be considered to ensure reliable and accurate operation across different conditions [5]. Before altering the input signal voltage, the system operates with two analog reference voltages, which are then converted into digital reference codes. Subsequently, the input signal undergoes conversion into a digital code within the digital domain. During this process, the system accommodates variations in process, voltage, and temperature (PVT), including offset and delay of the comparator, fluctuations in reference current, and changes in clock frequency. To counteract the effects of PVT variations, digital calibration is employed to compensate for these discrepancies [6]. The emergence of multi-microphone technology in consumer electronics represents a significant advancement, particularly in speech development. This technology has become the benchmark for enhancing speech quality and clarity. When considering the examples highlighted, such as the utilization of additional channels and the linear hardware scaling required for analog paraphrasing, the necessity of such approaches in this paper comes into question. We explore whether there is a need for scattered signal representation and blind source separation (BSS) techniques to improve performance across channels while potentially reducing the requirement for additional analog-to-digital converters (ATCs) [7]. The key characteristics of Reservoir Computing (RC) can be condensed as follows. Initially, the input data destined for processing is directed towards the boundaries of the reservoir. The reservoir's node count should be sufficiently large, and ideally, these nodes should exhibit non-linear behavior. The input data is then projected onto the reservoir for mapping into a higher-dimensional space. In this augmented space, the potential for linear separation between different input signals at reservoir levels increases exponentially [8]. Biological systems typically operate in a non-episodic manner, with timeframes dictated by the computational demands of the specific task at hand. These systems continuously engage in resource-intensive calculations. For instance, in sensorimotor activities, responses are expected within a few hundred milliseconds, while tasks like discerning a 1 KHz tone require rapid processing cycles on a scale of 1 millisecond to effectively address variations [9]. To achieve heightened sensitivity, particularly concerning the feedback loop, it's crucial to minimize the regeneration time constant. This involves reducing both the circuit interconnect loop delay and the propagation delay of transistors. By ensuring a rapid regeneration time constant and optimizing transistor performance for high speed, sensitivity can be maximized while maintaining a compact circuit structure. This approach emphasizes the importance of minimizing delays and utilizing transistors effectively to achieve both speed and sensitivity [10]. This could result in the GPS receiver experiencing interference from its own signals. The process involves analog acquisition followed by digital processing, which segments the processing into distinct time intervals. This helps mitigate digital noise during the operation of the front end. By implementing digital segmentation, the adverse effects are alleviated. However, utilizing this approach necessitates sufficient storage capacity to manage the processed data effectively [11]. Utilizing X-ray diffraction and neutron diffraction, along with photographic techniques, can pose significant challenges. These methods are still evolving within the field, particularly in areas that have seen later development. However, there are advantageous interactions between them. No single photography technique universally applies to all crystallographic issues, as there is no flawless automatic diffractometer [12]. This article aims to offer concise

instruction on GAS for filter design, drawing from literature publications and common specifications until practical implementation is achieved. The primary objective is to advance single-step design techniques, which hold great promise in enhancing filter design processes. Specifically, the article will provide brief training on GAS, offer a compilation of feedback, and address the challenge of simultaneously sizing filters to meet grid template specifications. Additionally, it will explore the application of Finite Word Length (FWL) IIR digital filters in single-step design methodologies, introducing new approaches to filter design [13]. To address this issue, the decimation filter must be implemented in a way that disconnects the clock from the front-end clock. This paper explores different multi-rate schemes to accommodate various circuit components operating at distinct clock frequencies. Subsequent sections delve into recent experimental findings concerning existing ADCs, alongside discussions on advancements in the design of multi-rate ADCs and quarter-rate ADCs [14]. Examining power consumption, resolution, sample rate, and other relevant performance metrics, a comparative analysis of these analog-to-digital converters (ADCs) sheds light on their respective limitations. These converters are integral components responsible for transforming analog signals into digital format across different systems [15].

2. MATERIALS AND METHODS

Representation: Delegation involves taking on leadership responsibilities and embracing roles of influence, rather than simply observing others who appear competent. It's about genuinely feeling a sense of belonging and looking around to see where one fits in.

Signal Integrity: Signal integrity refers to the dependable transmission of electrical signals to effectively convey information in an organized fashion. It involves managing high-frequency electromagnetic interference from neighboring signals and mitigating the impact of disturbances like crosstalk, antenna effects, and electro migration, which can compromise signal reliability.

Implementation: Carrying out a project or Commencing utilization of something: Putting into effect a change/policy/program Dynamic and enacting its policies A proficient service sector is essential.

power Consumption: To determine consumption, you can calculate it on a daily, weekly, or monthly basis, depending on your preference or the device's usage pattern. This involves multiplying the power rating in kilowatts (kW) by the number of hours the device is used.

Signal Conditioning: Efficiently transforming an analog signal into digital information involves employing techniques such as switching and signal conditioning. This process is crucial for accurate data retrieval. Acting as the intermediary between the sensor and the system, the signal conditioner plays a vital role in ensuring the integrity of the system.

Aspect: Aspect refers to a component or characteristic of something. When considering whether to vote for a candidate, it's important to examine the different facets of their political agenda. So, let's begin by familiarizing ourselves with these features.

Analogue Signal Processing: Analog signal processing encompasses various applications, such as crossover filters utilized in loudspeakers, as well as controls like "Bass," "Treble," and "Volume" found in stereo systems. Additionally, TV sets often incorporate "tint" controls as part of analog signal processing. Common components involved in analog signal processing include capacitors, resistors, and inductors, serving as passive elements, alongside transistors or operational amplifiers acting as active components.

Digital Signal Processing: Digital signal processing (DSP) predominantly focuses on handling audio signals, as well as applications such as speech processing, radar, seismic analysis, sonar, voice recognition, and certain financial operations involving signal manipulation. For instance, DSP is essential in tasks like compressing speech for mobile devices and facilitating voice transmission on mobile networks.

Quantization Error: The scale is perpetually boundless. Values are distinct and clearly defined. This entails a compact conversion process or a limited batch. In the realms of Simulation and Embedded Systems, this refers to the accuracy of a value within computing, and the digital constraints imposed on its range. Representing real-world values involves approximations.

ARAS Method: This process involves droplet fragmentation, culminating in the creation of a charged jet discharge emanating from the apex of a cone. This discharge accelerates towards the opposing electrode, where it continues to form fibers. Electrospinning, as it's known, offers several significant advantages. Firstly, it enables the production of fibers with an extensive surface area, typically on the scale of nanometers.

Additionally, it facilitates the formation of extremely fine fibers. Moreover, electrospinning is versatile and straightforward to implement for various applications. The resulting fibers possess excellent mechanical properties, further enhancing their utility. Due to its simplicity and efficacy, many experts recommend this technique in the field [16]. When addressing the challenge of multivariate alignment, Multi Attribute Decision Making (MADM) techniques are employed to evaluate the state of current structures and identify equally effective replacements for Nearly Zero Energy Buildings (NZEB). Conducting comparisons aids in optimizing these replacements to adhere to NZEB standards. This evaluation facilitates the selection of appropriate renewal strategies and processes [17]. The production of biofuels from vegetable sources poses significant challenges and impacts on food safety. Despite their benefits such as high calorific value, higher octane number, and lower carbon footprint, first-generation biofuels derived from edible crops raise various concerns. These biofuels, including bioethanol from rice, corn, oats, sugarcane, wheat, and other crops, pose threats to food security due to competition for agricultural land and potential legal implications surrounding their production and consumption [18]. CWE is optimized for identifying geometric configurations, with the primary objective being the delineation of engagement zone boundaries. These boundaries mirror the contours of the working space and are contingent upon the mathematical portrayal of surfaces. Strategies for identifying CWEs revolve around the mathematical principles governing the geometry of the work area. There are primarily two classification categories for these approaches: individual representations and solid modeling techniques [19]. The exploration of alternative energy sources is gaining momentum due to mounting concerns. Efforts to gather supporting evidence have been heightened. With the rise in global energy demand, there's a need to contemplate substituting fossil fuels with renewable energy sources to mitigate environmental emissions. This shift isn't solely aimed at conservation but also at fostering sustainable development. Additionally, diligent follow-up actions are crucial in this endeavor [20]. In a geographic area, comprehensive research involving geology, remote sensing, and seismology is crucial for grasping both tectonic and non-tectonic phenomena. By delving into the geological aspects, including tectonic movements and erosional processes, researchers can elucidate the intricacies of the region's topography and morphological formations. These interdisciplinary studies are instrumental in deciphering the interplay between various geological processes [21]. This study focuses on the atomic or molecular vibrational absorption spectra, employing precise methods to examine the kinetics of halocarbon dissociation. It builds upon previous research (references 1-4) and delves into various technical aspects, driven by the significant interest in these products due to their industrial applications [22]. Selecting the appropriate mining technique is crucial for optimizing profits, reclaiming deposits, and ensuring a secure work environment for employees. Various methods have been employed in the past, with some proving successful while others require further refinement to operate efficiently [23]. The Varangian vice that ensues can be likened to the well-documented issue of multi-modality. A modified rendition of the Weber problem emerges as a notable aspect, alongside the concept of column formation. Employing a branch-and-price approach allows for resolution within a variant of the set covering formulation. Other methodologies approximate a mixed-full-time linearity through griming formulas. Furthermore, comprehensive findings from a detailed computational analysis are also provided [24]. Moreover, with the incorporation of distance measurement sensors, it is crucial to anticipate the presence of obstacles accurately. The system aids in this aspect by promptly detecting obstacles using distance sensors. Upon detection, the system swiftly transmits a warning signal to a processing unit, which then converts it into a blend of vibrations. These vibrations serve as alerts to the driver, conveying the presence of obstacles. Positioned within the driver's immediate vicinity, these vibrations are localized to a designated area within the seating arrangement, ensuring effective communication of potential hazards [25]. Energy planning for future energy scenarios aims to develop strategies to meet energy requirements efficiently. It involves exploring alternatives and integrating diverse energy sources in a balanced manner to address environmental, social, technological, and economic considerations across different contexts. The goal is to optimize energy substitution and supplementation while ensuring sustainability and addressing the demands of varying spatial and temporal dynamics [26]. The uncertainty surrounding a disaster encompasses numerous potential outcomes. Visuals are utilized to gauge the intensity of earthquakes. Conclusions pertinent to the aftermath of the disaster are drawn, considering both situational and pre-disaster factors, which serve as fundamental variables in decision-making processes [27]. The objective of the p-median problem is to strategically allocate a given number of facilities among potential sites in order to optimize certain criteria, such as minimizing costs or maximizing efficiency. In contrast, the Reverse p-median (RIM) problem focuses on the destructive scenario of an attack on a set of facilities. In this context, the aim is to reassign facilities in a way that maximizes the total distance, making it harder for the attacker to disrupt service to customers and minimize potential damage [28]. To identify the origin of the infection, isolated from nearby herds must be examined. Analyzing the connections among strains and investigating the epidemiology of S. The genotype of aureus holds significance. The coagulase (coa) protein of S. aureus serves as a primary factor, acknowledged as a critical phenotypic determinant, associated with the virus believed to be the causative agent [29]. As a result, the assessment of Advanced Rider Assistance Systems (ARAS) for two-wheelers has been neglected, despite notable distinctions in vehicle mechanics and injury severity in collision accidents compared to four-wheelers. Therefore, there is a growing emphasis on integrating

two-wheelers into ARAS evaluation frameworks. This research specifically concentrates on implementing ARAS collision warning systems for two-wheelers, examining their organizational aspects, conducting real-world experiments (RS), computer simulations, and cost-benefit analyses to assess their effectiveness in reducing accidents [30].

3. RESULTS AND DISCUSSION

TABLE 1. Analogue and Digital Single Processing

	Aspect	Analogue Signal Processing	Digital Signal Processing	Quantization Error
Representation	200	99	161	75
Signal Integrity	100	55	121	85
Implementation	300	44	131	95
Power Consumption	400	66	141	65
Signal Conditioning	350	33	171	45

Table 1 shows the Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error.

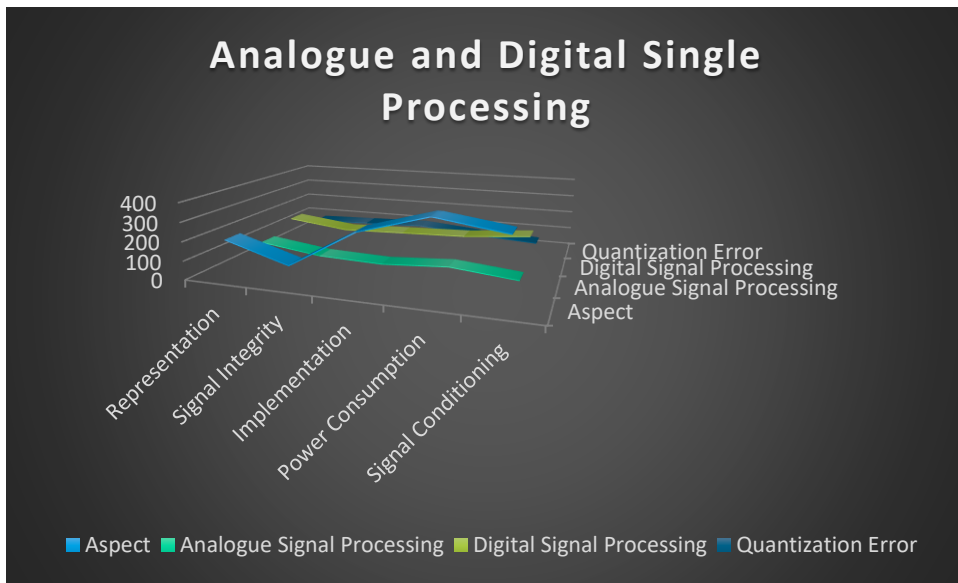


FIGURE 1. Analogue and Digital Single Processing

Figure 1 shows the Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error. From the figure 1 and table 1 it is seen that Power Consumption is showing the Highest Value for Aspect and Signal Integrity is showing the lowest value. Representation is showing the Highest Value for Analogue Signal Processing and Signal Conditioning is showing the lowest value. Signal Conditioning is showing the Highest Value for Digital Signal Processing and Signal Integrity is showing the lowest value. Implementation is showing the Highest Value for Quantization Error and Signal Conditioning is showing the lowest value.

$$X_{max} = \text{Max}(X_1, \dots, X_n) \quad (1)$$

TABLE 2. Calculation of maximum value

	Aspect	Analogue Signal Processing	Digital Signal Processing	Quantization Error
Max	400	99	171	95
Representation	200	99	161	75
Signal Integrity	100	55	121	85
Implementation	300	44	131	95
Power Consumption	400	66	141	65
Signal Conditioning	350	33	171	45

Table 2 shows the Calculation of maximum value Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error.

$$X_{1nor} = \frac{X_1}{\Sigma(X_1 + X_2 \dots X_n)} \quad (2)$$

TABLE 3. Normalized Matrix

	Aspect	Analogue Signal Processing	Digital Signal Processing	Quantization Error
Max	0.228571	0.25	0.190848	0.206522
Representation	0.114286	0.25	0.179688	0.163043
Signal Integrity	0.057143	0.138889	0.135045	0.184783
Implementation	0.171429	0.111111	0.146205	0.206522
Power Consumption	0.228571	0.166667	0.157366	0.141304
Signal Conditioning	0.2	0.083333	0.190848	0.097826

Table 3 shows the normalized matrix for Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error is the normalized values.

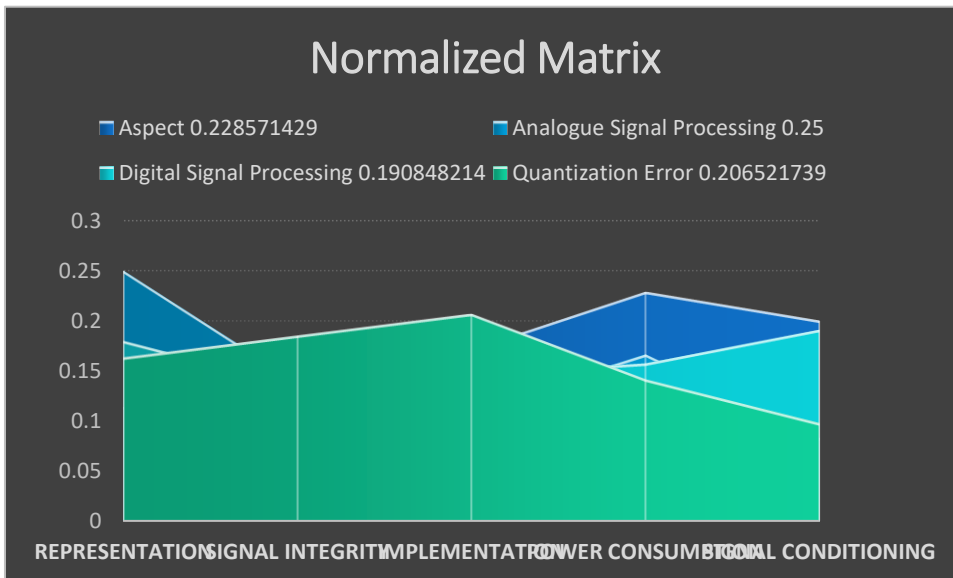


FIGURE 2. Normalized matrix

Figure 2 shows the normalized matrix for Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error is the normalized values.

$$X_{wnormal1} = X_{n1} \times w_1 \quad (3)$$

TABLE 4. Weighted Normalized Matrix

	Aspect	Analogue Signal Processing	Digital Signal Processing	Quantization Error
Max	0.057143	0.0625	0.047712	0.05163
Representation	0.028571	0.0625	0.044922	0.040761
Signal Integrity	0.014286	0.034722	0.033761	0.046196
Implementation	0.042857	0.027778	0.036551	0.05163
Power Consumption	0.057143	0.041667	0.039342	0.035326
Signal Conditioning	0.05	0.020833	0.047712	0.024457

Table 4 shows the weighed normalized matrix for the shows the normalized matrix for Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error it is also the weighed normalized matrix value.

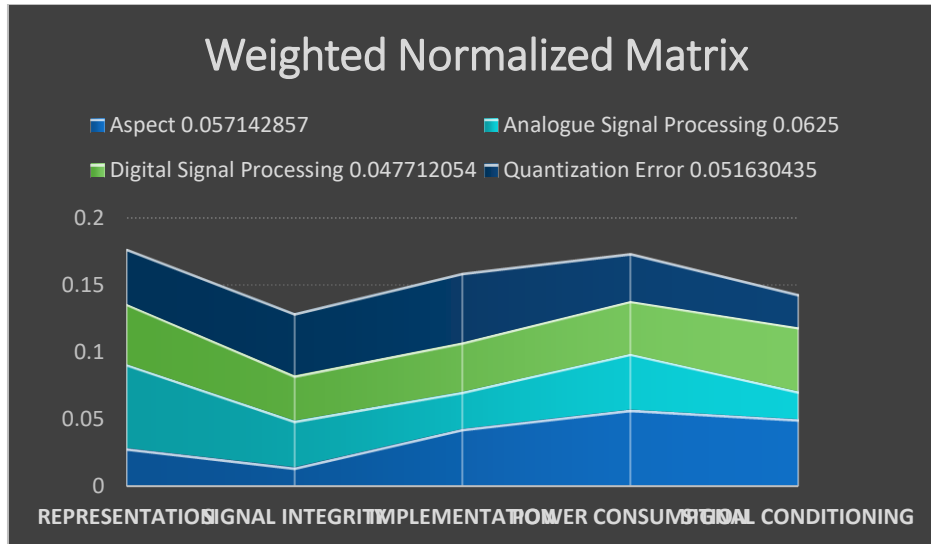


FIGURE 3. Weighted Normalized Matrix

Figure 3 shows the weighed normalized matrix for the shows the normalized matrix for Analogue and Digital Single Processing for Analysis using ARAS Method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error it is also the weighed normalized matrix value.

$$S_i = \sum(X_1 + Y_1 \dots Z_n) \quad (4)$$

$$K_i = \frac{X_{wnor1}}{\sum(X_{wnor1} + X_{wnor2} \dots X_{wnorn})} \quad (5)$$

TABLE 5. Final Result

	Si	Ki	Rank
	0.218985	1	
Representation	0.176754	0.80715	1
Signal Integrity	0.128965	0.588921	5
Implementation	0.158817	0.72524	3
Power Consumption	0.173477	0.792185	2
Signal Conditioning	0.143002	0.653021	4

Table 5 shows the final result and rank of the Analogue and Digital Single Processing in Additive Ratio Assessment method. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error and it shows the SI , KI, Rank. SI values are derived by using the formula(4), And KI values.

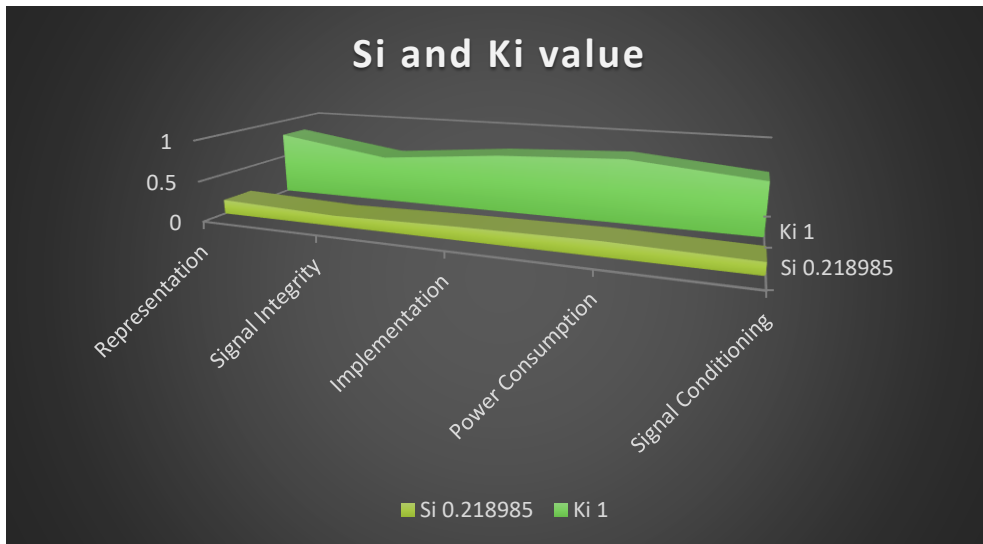


FIGURE 4. Si and Ki

Figure 4 shows the weighted normalized matrix in Analogue and Digital Single Processing. Representation, Signal Integrity, Implementation, Power Consumption and Signal Conditioning. Aspect, Analogue Signal Processing, Digital Signal Processing and Quantization Error. In SI method Representation is showing the highest value and Signal Integrity is showing the lowest value for KI method Representation is showing the highest value and Signal Integrity is showing the lowest value of weighted normalized data.

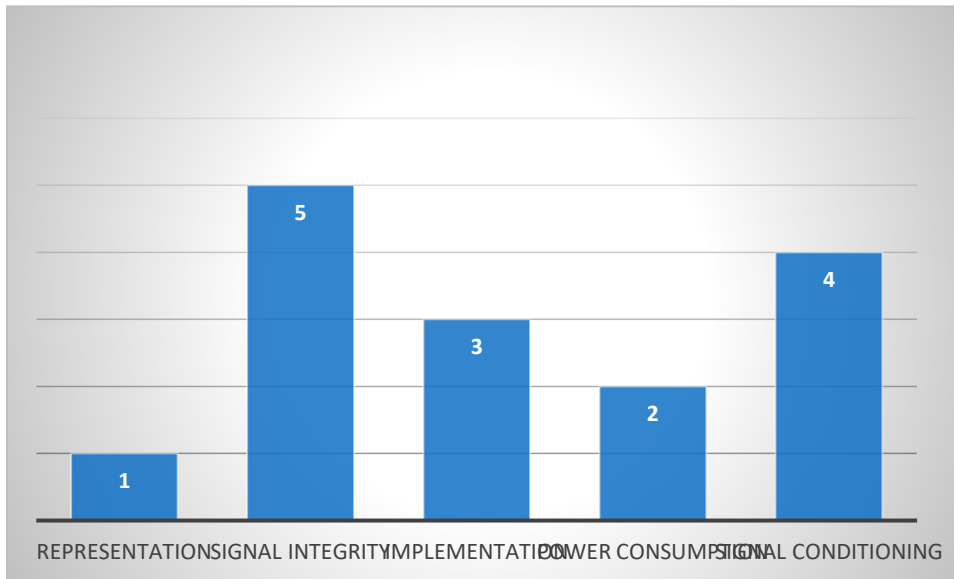


FIGURE 5. Shows the Rank

Figure 5 shows the Rank Power System and its Automation for Additive Ratio Assessment method. Representation is showing the highest rank and Signal Integrity is showing the lowest rank.

4. CONCLUSION

The model incorporates analog parameters such as NF-kB peak intensity, response time, and the number of oscillations, which subtly encode a set of instructions to modify cellular behavior in response to TNF-a-induced NF-kB signaling. This model aims to be widely applicable, incorporating both digital measurements and analog dynamics, as well as capturing various exposure profiles. Analysis of Signal-to-Noise Ratio (SNR) on an octave basis reveals that a 1-bit change in slope occurs from sample to sample, indicating variability linked to what is termed aperture jitter or aperture uncertainty. This variability, referred to as character, is further influenced by the ambiguity inherent in sample speed comparators, particularly in their ability to accurately discern the relative amplitudes of input voltages. Utilizing Nano amp reference currents can effectively reduce power dissipation in analog circuits. However, it's crucial to note that variations in voltage, temperature, and process (PVT) can distort the overall performance of the SS ADC. The emergence of multi-microphone technology in consumer electronics represents a significant advancement, particularly in speech development. This technology has become the benchmark for enhancing speech quality and clarity. When considering the examples highlighted, such as the utilization of additional channels and the linear hardware scaling required for analog paraphrasing, the necessity of such approaches in this paper comes into question. This discharge accelerates towards the opposing electrode, where it continues to form fibers. Electrospinning, as it's known, offers several significant advantages. Firstly, it enables the production of fibers with an extensive surface area, typically on the scale of nanometers. The production of biofuels from vegetable sources poses significant challenges and impacts on food safety. Despite their benefits such as high calorific value, higher octane number, and lower carbon footprint, first-generation biofuels derived from edible crops raise various concerns. These biofuels, including bioethanol from rice, corn, oats, sugarcane, wheat, and other crops, pose threats to food security due to competition for agricultural land and potential legal implications surrounding their production and consumption. These boundaries mirror the contours of the working space and are contingent upon the mathematical portrayal of surfaces. Strategies for identifying CWEs revolve around the mathematical principles governing the geometry of the work area. As a result, the assessment of Advanced Rider Assistance Systems (ARAS) for two-wheelers has been neglected, despite notable distinctions in vehicle mechanics and injury severity in collision accidents compared to four-wheelers. Therefore, there is a growing emphasis on integrating two-wheelers into ARAS evaluation frameworks.

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