# SYSTEM AND METHOD FOR CONTINUOUS-TIME PIPELINE ADC WITH REDUCED IN-BAND TRANSFER-FUNCTION DROOP

## IITM Technology Available for Licensing

### Problem Statement

- The use of identical stages in a multi-stage Continuous-Time Pipelined (CTP) Analog-to-Digital Converter (ADC) leads to a notable in-band droop, causing a detrimental impact on both the Signal-to-Quantization Noise Ratio (SQNR) and overall conversion performance.
- While some **existing multi-stage CTP ADCs utilize impedance scaling** and second-order Butterworth stages to alleviate droop, they are limited in fully addressing the cumulative droop throughout the entire pipeline, especially when multiple stages are cascaded together.
- Moreover, **the droop present in the filter transfer function within the signal band can result in a decrease in SQNR**, especially affecting input frequency components near the band-edge frequency. This can greatly impede the converter's reliability when it comes to various input variations.

### Intellectual Property

- IITM IDF Ref. **2301**
- **IN 441016 - Patent Granted**

### Technology Category/ Market

**Category- Analog-to-Digital Conversion (ADC) Systems**

**Applications** - Communications, Industrial Automation

**Industry -** Telecommunications, Healthcare, Automotive Electronics

**Market -** The analog to digital converter market is anticipated to flourish at an average **CAGR of 5.7%** between 2023 and 2033 and is likely to reach a value of US$ 3.51 billion in 2023.

### TRL (Technology Readiness Level)

**TRL - 4: Technology validated in lab scale.**

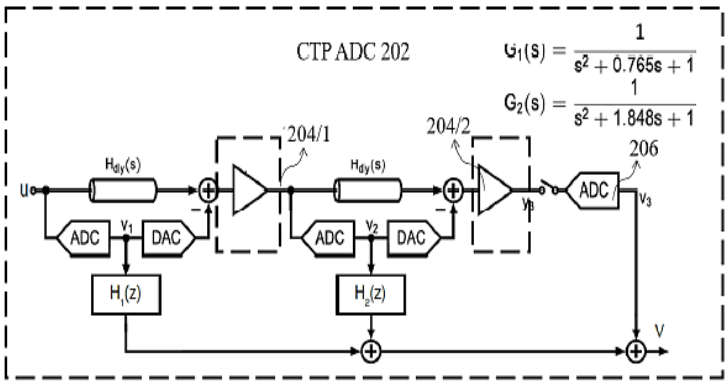


**FIG.1. Depicts an exemplary embodiment of a multi-stage continuous-time pipeline (CTP) analog-to-digital converter (ADC) with non-30 identical transfer function.**

### Technology

- The present invention discloses **a system and method for a continuous-time pipeline (CTP) analog-to-digital converter (ADC)** which comprises the benefits of pipelining with continuous-time operation.

**The system incorporates at least one pipeline stage configured with non-identical amplifier filters, achieving a unique transfer function for each stage to reduce in-band transfer function droop.**

**By utilizing non-identical residue amplifying filters in each pipeline stage, the system effectively reduces droop in the signal band, enhancing overall performance.**

**The system features a computing application capable of determining the number of stages and filters, analyzing the non-identical transfer function, and determining transfer functions for non-identical pipeline stages.**

### Research Lab

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## Technology Contd.

**Unlike conventional approaches, the system is designed to realize an overall transfer function rather than selecting transfer functions for individual pipeline stages.**

**The method provides flexibility by allowing the use of non-identical residue-amplifying filters such as Butterworth and Chebyshev filters, catering to user or application-specific requirements. The overall Butterworth design achieves higher Signal to Quantization Noise Ratio with lower droop at the band edge.**

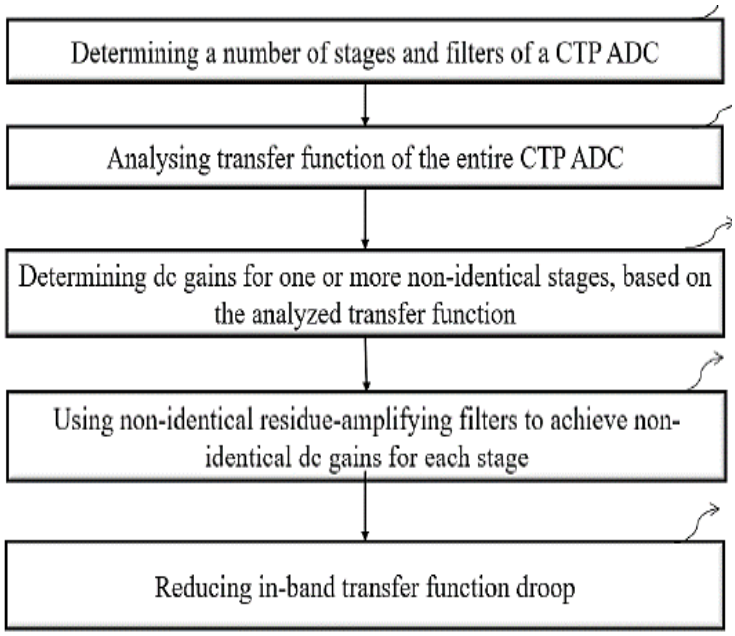


**FIG. 2. Method for the CTP ADC with reduced in-band transfer-function droop.**

## Key Features / Value Proposition

### Market Advantage:

**1. Enhanced Performance:** Non-identical transfer functions in each stage reduce in-band droop, improving Signal-to-Quantization Noise Ratio (SQNR) and overall ADC performance.

### Key Features:

**2. Continuous-Time Operation:** Leverages the benefits of continuous-time operation in a pipeline ADC, combining efficiency with high-speed conversion.

**3. Tailored Transfer Functions:** Appropriate design of non-identical transfer functions per stage optimizes the equivalent anti-alias filter, maintaining high-frequency attenuation while minimizing in-band droop.

### Competitive Edge:

**4. Adaptive Butterworth Function:** Realizes an overall Butterworth transfer function, offering a competitive advantage over systems with individually chosen Butterworth transfer functions for each stage.

### Industry Innovation:

**5. Integrated System Design:** The CTP ADC system integrates non-identical filters and backend ADC seamlessly, presenting an innovative solution for improved performance without sacrificing design simplicity.

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