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Design of a multi-function analog ASIC for reading out large SiPM-based systems

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Most future projects for hadronic calorimeters involve the use of multi-channel photodetectors (SiPMs) to achieve high readout granularity, allowing for improved jet resolution and better access to the substructure of overlapping jets.
Reading out each individual channel, especially for large calorimeters, would result in an uncontrollable and prohibitive increase in the number of channels to be digitized.
A new versatile high-bandwidth analog device that can amplify and sum individual photodetector channels in a fully configurable manner could be used to mitigate the problem. Such a device offers the advantage of fully configurable readout granularity that can be adjusted based on the type of process being analyzed or different calorimeter regions.
The feature that differentiates the device from similar ones available on the market is its ability to perform programmable analog sums of any channel subset. This allows for selection of readout regions of interest of the analog signal pattern before digital conversion.
A first prototype of this device, developed with high-bandwidth IC, has been designed and tested at INFN Pisa. The prototype is capable of generating the analog sum of up to 64 input signals. Input signal equalization or weighting can be achieved through a programmable gain before the analog sum. Additionally, the output signal can be amplified to fit the dynamic range of any external digitizer. The complete device configuration is done through a custom GUI.
The prototype tests provide excellent results in terms of pulse shape stability, time jitter, and linearity of the analog sum of an arbitrary number of channels.
A 64-channel ASIC version of this device, suitable for both research and industrial applications, is currently under development.

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