

Overview

The OpIMA project aims at developing next-generation pulse coders with particular reference to actuation, signal synthesis and audio amplification tasks. Modulations have so far represented in engineering little more than smart ways to exploit the characteristics of transmission means. Yet, they can more generally be seen as a whole paradigm to represent information, where data is spread in time (and possibly space) throughout a signal or a signal vector. Specifically, pulse modulations (such as width, position, density, frequency modulations, namely PWM, PPM, PDM, PFM) exploit this property to allow a discrete-valued wave (thus manageable in similar terms as a digital one) to exhibit analog-like properties, such as the ability to be directly processed by continuous filters and physical plants. This property has been exploited for a very long time in actuation, yet without thoroughly catching all its implications. Specifically, switched mode regulators and amplifiers take advantage of pulse modulations to control the operation of a switching bridge that rules how energy should flow, in a discontinuous and highly efficient way, from a source to a plant, be it an electric engine, a loudspeaker, or a general electric apparatus. However, in most cases the ability to achieve power regulation-goals is more a side effect of the modulator properties than the deliberate result of smart coding.

The goal of the project is to develop new coders, similar in usage to traditional ones, and to some extent even compatible with them (to enable rapid acceptance) yet operating on a complete different concept. Rather than being based on traditional/standard modulations, the coders developed during the project shall be explicitly designed for performance, by the extensive application of optimization techniques and the individuation of salient mathematical properties. In simple terms, given an information content to be represented, a formal list of constraints and a list of goals contributing to the formulation of quantitative merit factors, the final decision on how to code the information shall be produced by an explicit attempt to optimize the merit factors themselves.