

# Triplet Markov models

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Hidden Markov models (HMMs) are widely applied in various problems occurring in different areas like biosciences, climatology, communications, ecology, econometrics and finances, or still image or signal processing. In such models, the hidden process of interest  $X$  is a Markov chain, which must be estimated from an observable one  $Y$ , interpretable as being a noisy version of  $X$ . The success of HMC is mainly due to the fact that the conditional probability distribution of the hidden process with respect to the observed process remains Markov, which makes possible different processing strategies such as Bayesian restoration. HMMs have been recently generalized to "Pairwise" Markov models (PMMs) and "Triplet" Markov models (TMMs), which offer similar processing advantages and superior modeling capabilities. In PMMs, one directly assumes the Markovianity of the pair  $(X, Y)$  and in TMMs, the distribution of the pair  $(X, Y)$  is the marginal distribution of a Markov process  $(X, U, Y)$ , where  $U$  is an auxiliary process, possibly contrived.

For hidden discrete process, TMMs extend known models like hidden semi-Markov models or hidden bivariate models, or still Dempster-Shafer theory of evidence based hidden models. Parameter estimation methods are available leading to unsupervised Bayesian processing.

For hidden continuous process, particular TMMs allow one to consider fast optimal filtering in switching systems. Such systems are of particular interest as they allow approximating any non-linear Markov stationary system.