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# Weak rate of convergence of the Euler-Maruyama scheme for stochastic differential equations with non-regular drift

Arturo Kohatsu-Higa\*    Antoine Lejay†    Kazuhiro Yasuda‡

## Abstract

We consider an Euler-Maruyama type approximation method for a stochastic differential equation (SDE) with a non-regular drift and regular diffusion coefficient. The method regularizes the drift coefficient within a certain class of functions and then the Euler-Maruyama scheme for the regularized scheme is used as an approximation. This methodology gives two errors. The first one is the error of regularization of the drift coefficient within a given class of parametrized functions. The second one is the error of the regularized Euler-Maruyama scheme. After an optimization procedure with respect to the parameters we obtain various rates, which improve other known results.

**Keywords.** Stochastic differential equation, Euler-Maruyama scheme, discontinuous drift, weak rate of convergence, Malliavin calculus.

**MSC (2010):** Primary 65C30, 60H10

## 1 Introduction

The Euler-Maruyama scheme is a simple and efficient numerical scheme to simulate solutions of multi-dimensional stochastic differential equations (SDE's) such as

$$X_t = x + \int_0^t \sigma(s, X_s) dB_s + \int_0^t b(s, X_s) ds, \quad (1)$$

where  $B$  is a multi-dimensional Brownian motion. In many situations, one is interested in computing quantities of the type  $\mathbb{E}[f(X_T)]$  for some  $T > 0$  and  $f \in \mathfrak{F}$  where  $\mathfrak{F}$  is a class of functions. For a fixed number  $n$  of steps, consider  $n$  independent Gaussian random vectors

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