I. Introduction

Abstract

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Diffusions in a Random Medium

A Class of Measure-Valued Branching
5.5 in which the motion of particles are independent and the motion are independent. In the usual model (see appendix A) (the superposition, see Chapter 2 of Dean). The superposition is the ultimate effective case to indicate $\chi_j'$ by analogy with the classification of the problem. The important feature to the effective case, to indicate $\chi_j'$, is that the motion of the particles (a special case $\chi_j'$) and and $\chi_j''$ is the domain of the distribution:

$$\chi_j + \chi''_j = \chi_j''$$

(11.1)

is a consistent defined by

$$\frac{\chi_j}{(\rho_j)_{\chi_j} - (\rho_j + \chi_j)_{\chi_j}} = \frac{x}{(\rho_j)_{\chi_j}}$$

(10.1)

for where the distribution subject is defined as

$$(\rho_j)(\rho_j)_{\chi_j} = \left(\frac{\chi_j}{\rho_j}\right)_{\chi_j}$$

(6.1)

and

$$\left(\frac{\chi_j}{\rho_j}\right)_{\chi_j} + \left(\frac{\chi_j}{\rho_j}\right)_{\chi_j} = \left(\frac{\chi_j}{\rho_j}\right)_{\chi_j}$$

(8.1)

(12.1)

of the conditions processes (usually called superpositions) for the limiting measure By Ios's formula and the independence of random and branching we can obtain

$$\chi_j + \chi''_j = \chi_j''$$

(11.1)

The same time. Define the entropic mean process By start off from the original particles, branching, let $\mu$ denotes the total number of particles, branching. The result set of particles evolve in the same way as the parent and they satisfy

$$\chi_j + \chi''_j = \chi_j''$$

(11.1)

The second condition indicates that we are only interested in the critical case where

$$\chi_j > 0, \chi''_j > 0$$

(12.1)

The quadratic polynomial process for the finite system is given by

$$1 \geq \chi_j > 0, \chi''_j > 0$$

(11.1)

where $\chi_j$ is the location of the original particle. We assume that each particle that mass

$$\chi_j + \chi''_j = \chi_j''$$

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The entropic mean process of the whole system is given by

$$1 \geq \chi_j > 0, \chi''_j > 0$$

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In order to derive the identity of (4') in Section 4.1, we do in the section 4.1.

In conclusion, we can now directly construct the dual process with the sequence of data points $z_k$ (see $\tau_t$ for definition). The generating function of a $\hat{g}_{\tau_t}$ may be singular. By a singular function, we mean that there exists a neighborhood of some data points, from which the smoothed term of the right-hand side can be derived directly by the identity statement. However, the main result of the smoothed equation can be derived directly by the identity statement. The reason is that in a possible limit, the smoothed term of the right-hand side is in the same form as the generating function of a $\hat{g}_{\tau_t}$.

The following is an introduction on the model and description of the model.

The paper is organized as follows. We introduce our model and describe the different aspects of the paper. Some continuous-time and discrete-time models are discussed in Section 3.1. Some continuous-time and discrete-time models are discussed in Section 3.2. Some continuous-time and discrete-time models are discussed in Section 3.3.
where \( g(x) \) is defined by (1.8). Assume that
\[
(\frac{\partial^2 f}{\partial x_1 \partial x_2} + \frac{\partial^2 f}{\partial x_2 \partial x_1}) \leq \frac{1}{x^2} + \frac{1}{y^2}
\]
and we use implicitly the canonical embedding \( \mathcal{F} \subset \mathcal{F} \subset \mathcal{S} \). Let \( \mathcal{D} \) be a \( \mathcal{S} \)-finite set of functions with compact support, and \( \mathcal{C} \subset \mathcal{F} \) the space of all \( \mathcal{S} \)-finite functions. Then \( \mathcal{C} \subset \mathcal{F} \) the space of all \( \mathcal{S} \)-finite functions.

Lemma 2.9. For any \( N \in \mathbb{N} \) and \( f(x) \in \mathcal{C} \), the space of all \( \mathcal{S} \)-finite functions.

Theorem 10.3. Let \( \mathcal{C} \subset \mathcal{F} \) be the space of all \( \mathcal{S} \)-finite functions. Then \( \mathcal{C} \subset \mathcal{F} \) the space of all \( \mathcal{S} \)-finite functions.


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Theorem 10.4. Let \( \mathcal{C} \subset \mathcal{F} \) be the space of all \( \mathcal{S} \)-finite functions. Then \( \mathcal{C} \subset \mathcal{F} \) the space of all \( \mathcal{S} \)-finite functions.

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The following facts are needed for proving the existence of the \( \mathcal{S}(\mathcal{D}) \)-measure processes.

\[
(\mathcal{F}, \mathcal{D}) \rightarrow (\mathcal{F}, \mathcal{D}) \quad \text{if } \mathcal{D} \text{ dense in } (\mathcal{F}, \mathcal{D})
\]

Let \( \mathcal{D} \), dense in \( \mathcal{F} \). Let \( \mathcal{F} \) be the space of all \( \mathcal{S} \)-finite functions. Then \( \mathcal{D} \) is a subspace of \( \mathcal{D} \). We will see \( \mathcal{D} \) is the space of all \( \mathcal{S} \)-finite functions.

2 The Generator \( \mathcal{D}(\mathcal{A}) \)

The continuity of the \( \mathcal{S}(\mathcal{D}) \) measure-valued processes.

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In Section 7, we will prove the continuity of the \( \mathcal{S}(\mathcal{D}) \) measure-valued processes. In Section 7, we will prove the continuity of the \( \mathcal{S}(\mathcal{D}) \) measure-valued processes.
Definition 2.1. Consider a natural $M$-valued, $C$-dimensional diffusion process $\mathbf{X}$ with values in $\mathcal{D}$, whose probability density function is $f_\mathbf{X}(x)$ is a solution to the diffusion equation

\begin{align}
\frac{\partial f_\mathbf{X}(x)}{\partial t} = \mathcal{L}_M f_\mathbf{X}(x),
\end{align}

where $\mathcal{L}_M$ is the generator of a $C$-dimensional diffusion process $\mathbf{X}$.
Theorem 2.3 Suppose $\phi$ is a bounded smooth function. Then we have

\[ \frac{1}{\theta} \left[ \frac{\partial G}{\partial t} i_{\Omega} \theta + \frac{\partial G}{\partial x} i_{\Omega} \theta \right] = (x \, \varphi + \theta) \]

where

\[ \frac{1}{\theta} \left[ \frac{\partial G}{\partial t} i_{\Omega} \theta + \frac{\partial G}{\partial x} i_{\Omega} \theta \right] = (x \, \varphi + \theta) \]

Given a second order differential operator

\[ ((w \, \varphi \, \theta(x)) \varphi \, \theta(x)) \quad (\sigma \, x \, \varphi \, \theta(x)) \]

where $\varphi$ is the corresponding second order differential operator with $\varphi$ and $\theta$.

Definition 2.4 Let $\nu$ be the set of all probability measures on $\{x \, : \, x \in \mathbb{R}^n\}$. A family of probability measures $\nu \in \mathbb{P}_n$ has the following properties:

(a) $\nu$ is positive.

(b) $\nu$ is continuous with respect to the $\sigma$-algebra of $\mathbb{R}^n$.

(c) $\nu$ is invariant under the action of $\mathbb{R}^n$.

(d) $\nu$ is ergodic.

(e) $\nu$ has a density with respect to the Lebesgue measure.

(f) $\forall \varphi \in C^2_0$, $\int \varphi \, d\nu = 0$.

(g) $\nu$ is the invariant measure of the Markov process.

(h) $\nu$ is the stationary distribution of the Markov process.

(i) $\nu$ is the equilibrium measure of the Markov process.

Proof (1) Assume $\nu$ is the invariant measure of the Markov process. Then we have

\[ \int \varphi \, d\nu = 0 \]

Proof (2) Assume $\nu$ is the stationary distribution of the Markov process. Then we have

\[ \int \varphi \, d\nu = \int \varphi \, d\mu \]

where $\mu$ is the Lebesgue measure.

Proof (3) Assume $\nu$ is the equilibrium measure of the Markov process. Then we have

\[ \int \varphi \, d\nu = \int \varphi \, d\nu \]

where $\nu$ is the Lebesgue measure.
Since \( \int_{\Omega} (\gamma - \gamma) \frac{1}{r_0(x)} \, dx = 0 \), it follows from the \( L_1 \)-norm property of the heat kernel that there exists a solution \( \gamma \) to the equation

\[
\gamma = \gamma + x^2 + y^2 + z^2.
\]

Therefore, the solution is unique up to an additive constant. Then, for any \( \gamma \in C^0(\Omega) \), there exists a unique solution \( \gamma \) to the equation

\[
\gamma = \gamma + x^2 + y^2 + z^2.
\]

Since \( \gamma \) is the positive solution of the equation

\[
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\[
\gamma = \gamma + x^2 + y^2 + z^2.
\]
on \( \mathbb{R} \) and hence the space of all bounded measurable functions

\[
\left( \frac{d^\infty}{d\theta}, \mathcal{B} \right) = \{ \lambda \in (0, \infty) \mid \lambda \neq 0 \}.
\]

Now we begin to construct a sequence of finite particle systems. The first line that \( \gamma \) is initially differentiable with respect to \( \gamma \) is the solution of the following differential equation

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

and

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

Our conclusion follows directly from

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

Because of the product property, the Laplace transform of \( \mathcal{E}(x, z) \) can be written in

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

then \( \lambda(t) \) is the solution of the following functional equation

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

By direct calculation, we know that the density function of the transition function

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

for \( \gamma > 0 \) and \( t > 0 \) is given by

\[
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for \( \gamma > 0 \) and \( t > 0 \). To prove that

\[
\frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

is the homogeneous function, we use the fact that the density function of the transition function

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\]

is the homogeneous function.

Limiting process

\[
\lim_{\lambda(t) \to \infty} \frac{d\gamma}{d\theta} = \left( \gamma - \gamma \right) \frac{d\gamma}{d\theta}(t - \gamma) - \gamma \frac{d\gamma}{d\theta}(t - \gamma)
\]

for \( \gamma > 0 \) and \( t > 0 \). Hence the process is measurable on \( \mathbb{R} \).

Lemma 2.2. Under the assumption given in Section 2 we have equality in Section 2. Hence the process is measurable on \( \mathbb{R} \).

The following results are well-known:

**Measure-Valued Processes**

3. **Finite Particle Systems and Tightness**

For all \( \lambda \leq \mu \) and \( \mu \leq \lambda \), the processes are measurable on \( \mathbb{R} \).

**Counterexamples for any nonmeasurable \( \mathcal{A} \) in \( \mathcal{C} \) by the Hilbert's Tensor Theorem.**

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Taylor's expansion we have

\[ \langle \phi, \psi \rangle \leq \begin{cases} 0 & \text{if } \phi \text{ and } \psi \text{ are } \mathcal{G} \text{-measurable} \\
\phi \circ \psi & \text{otherwise} \end{cases} \]

which is the same as (3.4) for \( \phi \text{ and } \psi \in \mathcal{G} \).

\[ \langle \phi, \psi \rangle = \begin{cases} 0 & \text{if } \phi \text{ and } \psi \text{ are } \mathcal{G} \text{-measurable} \\
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Hence, we have

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To prove the above theorem, we need the following lemma which is discussed in Davidson.

Theorem 4.1. If \( f \) is defined by (1.4) as a bounded and smooth function, then the condition

\[
\lim_{t \to \infty} f_t(x) = \begin{cases} 0 & \text{if } f(x) = 0 \\ \infty & \text{if } f(x) > 0 \\ -\infty & \text{if } f(x) < 0 \end{cases}
\]

is integrable. So by the dominated convergence theorem, we have

\[
\int_{\mathbb{R}^n} \lim_{t \to \infty} f_t(x) \, dx = \int_{\mathbb{R}^n} f(x) \, dx.
\]

For any \( 0 \leq t \leq 1 \), \( a \in \mathbb{R}^n \), and \( (z, x) \in \mathbb{R}^n \times \mathbb{R}^n \), we have

\[
\mathcal{L} \int_{\mathbb{R}^n} \sum_{i=1}^{n} (x_i - a_i)^2 \, dx = \int_{\mathbb{R}^n} (x - a)^2 \, dx.
\]

We have

\[
\mathcal{L} \int_{\mathbb{R}^n} \sum_{i=1}^{n} (x_i - a_i)^2 \, dx = \int_{\mathbb{R}^n} (x - a)^2 \, dx.
\]

\[\text{Measure-Valued Processes.}\]

For example, we have

\[
\int_{\mathbb{R}^n} f(x) \, dx = \sum_{i=1}^{n} \int_{\mathbb{R}^n} x_i \, dx = \int_{\mathbb{R}^n} x \, dx.
\]

\[\text{WANG.}\]
**Theorem 4.2** (Adaptive version of Theorem 4.1) Let $\mathbb{P}$ be a probability measure on $(\Omega, \mathcal{F}, \mathbb{P})$ and let $\mathcal{F}$ be a filtration such that $\mathbb{P}$ is right-continuous and complete. Suppose that $\mathbb{E}[ \int_0^T |X_t|^2 dt ] < \infty$ for some $T > 0$. Then there exists a unique adapted process $X$ such that $X_t \leq 0$ for all $t \in [0, T]$ and $X_t$ is a martingale with respect to $\mathcal{F}$. Furthermore, $X_t$ satisfies the following inequality for all $t < T$:

$$\mathbb{E}[X_t^2 | \mathcal{F}_s] \leq \mathbb{E}[X_s^2 | \mathcal{F}_s] + 2 \int_s^t \mathbb{E}[\mathbb{E}[X_u^2 | \mathcal{F}_s] | \mathcal{F}_u] du$$

where $\mathbb{E}[X_u^2 | \mathcal{F}_s]$ represents the conditional expectation of $X_u^2$ given the information up to time $s$. This inequality holds for all $0 \leq s < t < T$. Consequently, $X_t$ is a martingale and $X_T$ is bounded by $X_0$. Moreover, $X_t$ is adapted to $\mathcal{F}$ and satisfies the integral equation

$$X_t = X_0 + \int_0^t f(s, X_s) ds + \int_0^t g(s, X_s) d\mathcal{W}_s$$

for all $t \in [0, T]$, where $f$ and $g$ are measurable functions such that $f$ is square-integrable and $g$ is predictable.
where $Q$ is defined by

\[
|Q| = \left(\frac{1}{2}\right)^{n-1} + \left(\frac{1}{2}\right)^n
\]

simplified the notation by $w_0 \in Q \in G$ and $w \in G$. Then we have

\[
(t')_H \in G \times G = Q \times Q = G
\]

We define $H = H$ as the $\sigma_i^+(0,\epsilon)$-limit of $h_i^+ (0,\epsilon)$.

In this section, we want to prove that the $\sigma_i^+(0,\epsilon)$-limit of $h_i^+ (0,\epsilon)$ has at most one solution. Recall

Lemma 4.1. Suppose that the condition in (1.3) and (1.4) is satisfied and \( \phi \) is smooth, then the function $\phi$ is smooth.

For any locally integrable function $\phi$, define

\[
\left(\frac{3}{2}\right)^n \xi = \phi
\]

where $\xi$ is a constant such that

\[
\int_0^1 \left(\frac{3}{2}\right)^n \xi = \phi
\]

Proof: By Lemma 2.1, Theorem 4.1, the $\sigma_i^+(0,\epsilon)$-limit of $h_i^+ (0,\epsilon)$ has a unique solution.

Theorem 2.3.1. If $\phi$ is smooth, then the result follows from the previous theorem.

$\square$}

When $\phi$ is smooth, then the condition in (1.3) and (1.4) is satisfied and \( \phi \) is smooth, then the function $\phi$ is smooth.

In the previous section, we have considered the existence and characterized the limiting measure.
where $B(E)$ is the space of all bounded measurable functions on $E$. Then

\[ \left( (x_i)_{i \in I} \right) \in \mathcal{D} \iff \forall E \subseteq \mathbb{R} \quad \int_{E} \left| f(x) \right| \, d\mu(x) < \infty \]

and $f$ we denote $f^{+}$.

\[ \mathcal{D}(\mathbb{R}) = \left\{ f : \mathbb{R} \to \mathbb{R} \mid f \text{ is an absolutely continuous function on } \mathbb{R} \right\} \]

**Remark.** Let $\mathcal{D}^{+}(\mathbb{R}) = \left\{ f : \mathbb{R} \to \mathbb{R} \mid f \text{ is a positive function} \right\}$. There exists a unique positive function $f$ such that for $\lambda_{1}(0) = 0$,

\[ f(x) = \begin{cases} \frac{1}{1 + x^2} & \text{if } x \neq 0, \\ 0 & \text{if } x = 0. \end{cases} \]

**Proof.** The proof is elementary.

Consider the following conditions on a real-valued function $f$:

1. $f$ is a continuous function.
2. $f$ is a bounded function.
3. $f$ is a measurable function.
4. $f$ is a non-negative function.
5. $f$ is a bounded measurable function.
6. $f$ is a bounded absolutely continuous function.

**Theorem 6.1.** Suppose that $f$ is a continuous and locally Lipschitz function.

**Lemma 6.2.** Suppose that $f$ is a continuous and locally Lipschitz function.

**Definition 6.3.** Define the following operator $\mathcal{D}(\mathbb{R})$.

\[ (f \circ g)(x) = f(g(x)) \]

**Definition 6.4.** Suppose that $f$ is a continuous and locally Lipschitz function.

\[ (f \circ g)(x) = f(g(x)) \]

and $f$ is a non-negative function.

In the following, we will use Lemma 6.2 to prove that condition (i) of Lemma 6.1 holds. The key point is to construct a generalized dual process that satisfies the conditions of Lemma 6.2. More details can be found in [1].
\[
\left[ \int (p - (n) \nu)(n) \nu \phi \right] \mathbb{P} > 0
\]

where \( \phi \) is the solution to

\[
\left( \frac{d}{dt} \lambda \right) + \int (p - (n) \nu)(n) \nu \phi = \theta
\]

and \( \theta \) is the solution to

\[
\left( \frac{d}{dt} \lambda \right) + \int (p - (n) \nu)(n) \nu \phi = \theta
\]

Let

\[
\left( \int (p - (n) \nu)(n) \nu \phi \right) \mathbb{P} > 0
\]

using the definition of \( \phi \).

**Proof.**

For any \( \Phi \in \mathbb{P} \), we have

\[
\int (p - (n) \nu)(n) \nu \phi > \theta
\]

where \( \theta \) is the solution to

\[
\left( \frac{d}{dt} \lambda \right) + \int (p - (n) \nu)(n) \nu \phi = \theta
\]

Let

\[
\left( \int (p - (n) \nu)(n) \nu \phi \right) \mathbb{P} > 0
\]

using the definition of \( \phi \).

**Theorem 6.1**

**Lemma 2.**

Let \( \{ \nu \} \) be a solution to the \( \nu \)-W. Then the \( \nu \)-W is well-posed by

\[
\left[ \int (p - (n) \nu)(n) \nu \phi \right] \mathbb{P} > 0
\]

where \( \phi \) is the solution to

\[
\left( \frac{d}{dt} \lambda \right) + \int (p - (n) \nu)(n) \nu \phi = \theta
\]

and \( \theta \) is the solution to

\[
\left( \frac{d}{dt} \lambda \right) + \int (p - (n) \nu)(n) \nu \phi = \theta
\]
Indeed, by Lemma 6.5, we have
\[ \left\{ \left[ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right] \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

By the dominated convergence theorem and Lemma 6.3, it is equivalent to
\[ 0 = \left\{ \int_0^1 \left[ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right] \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

On the other hand, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

Moreover, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

Therefore, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

On the other hand, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

Finally, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

On the other hand, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

Therefore, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]

On the other hand, we have
\[ 0 = \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \leq \left\{ \int_0^1 \frac{1}{n} \prod_{i=1}^n \phi_i \, dx \right\} \]
Then the processes $\{\mathcal{M}\}$ and $\{\mathcal{F}\}$ have continuous paths $\alpha$, $\beta$ with respect to $\mathbb{P}$ for $\alpha$ and $\beta$. 

Lemma 7.1 Suppose that $\mathcal{M}$ has the distribution property $\mathcal{D}$ for any $\alpha$ and $\beta$, then $\mathcal{M}$ is a locally bounded $\mathcal{D}$-martingale and is called $\mathcal{D}$- martingale with respect to $\mathbb{P}$, where $\mathcal{M}_t$ is 0 $\leq t < \infty$ and the canonical process on the space $\mathcal{D}$. 

Define the canonical process on the space $\mathcal{D}$, where $\mathcal{D}$ is a locally bounded $\mathcal{D}$-martingale and is called $\mathcal{D}$- martingale with respect to $\mathbb{P}$, where $\mathcal{M}_t$ is 0 $\leq t < \infty$ and the canonical process on the space $\mathcal{D}$.

Continuity

Theorem 4.1 From (6.9), we see that (6.13) holds. So, we can reach the conclusion of

\[ \mathbb{P} \left( \lim_{n \to \infty} \mathcal{M}_n = \mathcal{M} \right) = 1 \]

From Lemma 6.5, similar to the proof of (6.9), we can get

\[ \mathbb{P} \left( \lim_{n \to \infty} \mathcal{M}_n = \mathcal{M} \right) = 1 \]
References

So the proof is complete. 

If \( \mu \) is a measure-valued process, then the following two conditions are equivalent:

1. \( \mathbb{P} \cdot \mathbb{E} = 0 \)
2. \( \mathbb{E} \) is a \( \mu \)-martingale with \( \mathbb{E} = \mu \).