CHAPTER 2

ECLeCTRONICS

This chapter introduces a relation between the study of biological neural systems and that of electronic neural systems. The chapter title, eclecticronics, is derived in the following manner:

- **ec·lectic** 1. selecting what is thought best in various doctrines, methods, or styles. 2. consisting of components from diverse sources.
- **electron·ic** of, based on, or operated by the controlled flow of charge carriers, especially electrons.
- **electron·ics** the science and technology of electronic phenomena and devices.
- **ec·lectronic·ics** the common framework of electrical properties used for information processing in both brain and silicon.

As we have mentioned, both neural and electronic systems represent information as electrical signals. Neurobiologists deal with neural systems, and have evolved a viewpoint, notation, jargon, and set of preconceptions that they use in any discussion of neural networks. Likewise, electrical engineers have developed an elaborate language and symbolism that they use to describe and analyze transistor circuits. In both cases, the language, viewpoint, and cultural bias derive partly from the properties inherent in the technology, and partly from the perspectives and ideas of early influential workers in the field. By now, it is extremely difficult
the field point mass, and is called the 

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The quantity \( f \) in Equation 2 is called the 

\[ f = \frac{d}{dW} \]

The quantity \( \theta \) in Equation 2 is called the 

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We can see that the position of an atom is determined by the field point mass, and is called the 

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Chapter 2: Basics

Fluid Model

Potential energy of the water in the system is proportional to the height of the water column in the reservoir. The potential energy is given by the equation:

\[ PE = mgh \]

where:
- \( PE \) is the potential energy of the water
- \( m \) is the mass of the water
- \( g \) is the acceleration due to gravity
- \( h \) is the height of the water column

The gravitational field is described as a potential field. Points in the fluid are connected by equipotential lines, which are lines of constant potential energy. The equipotential lines are orthogonal to the direction of the force of gravity.

\[ \nabla \phi = 0 \quad \text{in fluid} \]

where \( \nabla \phi \) is the gradient of the potential field. The electric potential gradient in an electric field is defined as:

\[ \nabla \phi = \frac{V}{d} \]

where:
- \( V \) is the potential difference
- \( d \) is the distance between two points in the field

The equipotential lines in the fluid correspond to the lines of constant electric potential in an electric field. The electric potential gradient is perpendicular to the equipotential lines.

\[ \nabla \phi = \frac{V}{d} = \frac{A}{d} \]

where:
- \( A \) is the electric field strength
- \( A \) is the area of the equipotential lines

The electric field strength is given by the gradient of the potential field. The electric field is the force per unit charge that a test charge experiences in an electric field.

\[ \vec{E} = \frac{1}{\epsilon_0} \nabla \phi \]

where:
- \( \vec{E} \) is the electric field
- \( \epsilon_0 \) is the permittivity of free space
- \( \nabla \phi \) is the gradient of the potential field

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Schematic Diagrams

Is a one-to-one correspondence and thus no confusion can result.

Schematic Diagrams are used to illustrate the relationships and interactions of the components of a system. They provide a visual representation of how the parts of a system interact with each other, making it easier to understand the system as a whole. Schematic diagrams are commonly used in engineering, electronics, and other fields to communicate complex information in a clear and concise manner.

The schematic diagram shown in Figure 1 is an example of a schematic diagram. It illustrates the connections between the various components of a system and how they interact with each other. The diagram includes labels for each component, as well as arrows indicating the direction of the signal flow. This type of diagram is particularly useful for engineers and technicians who need to understand how different parts of a system work together.
Although there are many details of any technology that can be discussed

**ACADEMIC DEVICES**

Academic computers work...
Chapter 2

Electronics

**The momentum of a particle is called the mass/velocity**

\[ \text{mass/velocity} = \frac{mg}{v} = m = \text{mass} \]

The force on a particle in the presence of an electric field is determined by the electric field and the charge on each particle.

\[ F = qE \]

**Equation (2)**

In the Lorentz force law, the behavior of a uniform distribution of electrons is described by integrating the behavior of a collection of electrons subject to Lorentz force.

\[ \frac{\text{mass}}{v} = \frac{I}{f} = \frac{f_0}{E} = \frac{y}{z} \]

The force per particle is the net change in momentum of a particle subject to Lorentz force.

\[ \frac{f}{y} = \frac{d}{E} = \frac{y}{y} \]

The Lorentz force law is used to determine the motion of a particle under the influence of an electric field.

**Equation (3)**

In the case of our model, the net change in momentum of the particle is given by

\[ \frac{d}{E} = \frac{y}{y} \]

In the Lorentz force law, the net change in momentum of the particle is given by

\[ \frac{d}{E} = \frac{y}{y} \]

**Equation (4)**

Starting from rest with acceleration, the equation for motion is derived from the Lorentz force law.

\[ \frac{d}{E} = \frac{y}{y} \]

The net change in the particle's momentum is given by

\[ \frac{d}{E} = \frac{y}{y} \]

**Equation (5)**

In the Lorentz force law, the net change in momentum of the particle is given by

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**Equation (6)**

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Consider a point in space and let the diffusion coefficient $D$ be a constant. The equation governing the change in concentration $C$ of a substance due to diffusion is given by

$$\frac{\partial C}{\partial t} = D \nabla^2 C$$

where $\nabla^2$ is the Laplacian operator. This equation is known as Fick's second law of diffusion.

At a specific point in space and time, the rate of change of concentration is proportional to the Laplacian of the concentration. The Laplacian of a function $f(x,y,z)$ in three dimensions is given by

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$$

In two dimensions, it simplifies to

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

The diffusion coefficient $D$ is a measure of the rate at which the concentration of a substance changes due to diffusion. It is a material property that depends on factors such as temperature and concentration gradients. In a homogeneous medium, $D$ is constant, but in heterogeneous media, it can vary with position.

**Figure 2.1**: Concentration profile for a substance diffusing from a point source. The concentration decreases exponentially with distance from the source. The diffusion coefficient $D$ characterizes the rate at which the concentration profile evolves.

**Figure 2.2**: Schematic of a diffusion process. The concentration profile $C(x,t)$ is shown as a function of position $x$ and time $t$. The diffusion coefficient $D$ is a constant that affects the rate of diffusion.

**Figure 2.3**: Concentration profile in a semi-infinite medium. The concentration $C$ decreases exponentially with distance from the source $N$. The diffusion coefficient $D$ plays a crucial role in determining the shape and evolution of the concentration profile.
The Boltzmann distribution is defined as:

\[ \frac{N}{N_0} = \frac{e^{-\frac{E}{kT}}}{N} \]

where \( N_0 \) is the density at the reference height. \( n \) is the density of both.

Part B: Basics

CHAPTER 2: ELECTRONICS

\[ n = \frac{b}{a} \]

\[ \frac{m}{N_0} = \frac{N}{N} \]

\[ \frac{m}{N_0} = \frac{N}{NP} \]

We can extend our previous result to a grid:

\[ \frac{m}{NP} = \frac{N}{NP} \]

The equilibrium of Equation 2.12 with respect to the grid:

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