

# Hegelian Philosophy and System Dynamics

Hadi Akbarzade Khorshidi

Marzieh Soltanolkottabi

Department of Industrial & Systems Engineering,  
Isfahan University of Technology, Isfahan, Iran, 84156-83111.

Tel: +983113912550, Fax: +983113915516

[h.akbarzadekhorshidi@in.iut.ac.ir](mailto:h.akbarzadekhorshidi@in.iut.ac.ir), [m.soltanolkottabi@in.iut.ac.ir](mailto:m.soltanolkottabi@in.iut.ac.ir)

**Abstract:** there are some similarities between Hegelian philosophy and system dynamics' theory. Hegel used a systematic view for his theory and generalized it to all categories. We try to express the similarity between the Hegel's theory and system dynamics' modes. In addition, a system dynamics' tool as Causal loop diagram is employed to explain the dynamic trend of Hegel's system. At last, we simulate an example of Hegel's philosophy by system dynamics' model.

**Keywords:** Hegel's philosophy, System dynamics, dialectic method, oscillation mode.

## 1. Introduction

“Genuine tragedies in the world are not conflict between right and wrong. They are conflicts between two rights.”

G.W.F. Hegel (1770-1831)

Hegel and his philosophy are well-known in the history of philosophy. This philosophy has a comprehensive view and has had a lot of effects on other ideologies. About importance of Hegel's philosophy should mention that some concepts of his philosophy have been employed in sociology, legislation, historicism and politics. Moreover Hegel's dialectic became a component of Marx theory [1]. Kaufmann in his book stated that Hegel as a philosopher have had the most effects on west and the perception of contemporary European history without understanding the Hegel's philosophy is impossible [2].

In this paper, we try to introduce the Hegelian philosophy by the system dynamics' tools and express the similarities between Hegel's system and system dynamics approach. In the following section, we describe the concepts and generality of the Hegelian philosophy. Section 3 introduces the system dynamics and its tools that are used and its modes that are appeared. In section 4, the similarity between Hegel's philosophy trend and system dynamics mode are illustrated and one of the system dynamics tools is employed to interpret the Hegelian method. Section 5 uses a stock and flow model to simulate the philosophical trend via an example. In the last section, the summary and results are brought.

## 2. Hegel's philosophy

In order to compare and investigate the Hegelian philosophy with system dynamic approach, it seems necessary to introduce the theory of Hegel and his thinking structure. According to Hegel's claim, the Hegel's theory is a summary of precede philosophies, but the effect of Greek idealism (like Eleatics, Plato and Aristotle) and Kant's philosophy on Hegel was more

than the other viewpoints [3]. Hegel didn't have a tendency to bring a new religion; he wanted to demonstrate the universal philosophy that transmitted between different eras [4]. In this section, we try to explain the Hegel's philosophy and its dimensions, in three subsections.

## 1. Logic, nature and spirit

Hegel's philosophy system includes three categories, 1) Logic, 2) Philosophy of nature, 3) Philosophy of spirit. These three categories make a triad in the philosophy of Hegel. In the following paragraphs, each category will be explained summarily.

*Logic:* Reason is the matter of logic. Reason includes two sets of categories: subjective categories and objective categories. Subjective categories are tools of human's thinking but objective ones have external aspects [3]. In Hegel's theory, logic is divided into three parts: 1) Being, 2) Essence, 3) Notion. These divisions are three stages about identifying things. Being is an explanation about what a thing is and describes the thing as independent. Essence is an answer to what components and regulations are related to the thing. Notion analyses the end of thing and development process of it. These three stages are successive, so that the first stage involves the second one for better description, and the second stage engages the third for this reason, and the third stage lie under the other stages [5]. Being doesn't need to mediators, essence depends on mediators and notion belongs to a zone that is combined by two others [3].

*Philosophy of nature:* In this category, the zone of pure thought is passed and the zone of things, matters and animals is initiated. In nature philosophy, Hegel's system transfers from thoughts to things. Hegel tried to create a principle for evolution and excellence of natural categories based on similarity to reason or idea in the world. According to this, latter categories are more valuable than former categories and always include the former ones [3]. The category of nature of his philosophy was not capable to analyze the natural phenomena. As a result of this category, Hegel made some mistakes and opposed some famous theories like evolution theory [6]. In Hegel's theory, natural metamorphosis accomplishes in three stages: 1) Mechanics, 2) Physics, 3) Organics. In mechanics, matter has no properties and qualities and is abstract. In physics, matters are being with properties and qualities but non-organic. In organics, there are three steps: 1) Geological organism, 2) Vegetable organism, 3) Animal organism; during these steps, nature is evolving and more complicated existents are emerging [3].

*Philosophy of spirit (mind):* The spirit is divided into three stages, too: 1) Subjective Spirit, 2) Objective Spirit, 3) Absolute Spirit. Subjective spirit contains human's mind, so the components of human consciousness like feeling, desire, intellect, etc. are evaluated. In this stage, spirit is a hidden spirit. In objective spirit, spirit comes out from his original shape and emerges in details. In other word, spirit moves from internal to external. Ethics and politics are assessed in objective spirit. Absolute spirit is the collector of two other stages. Absolute spirit is emanated in art, religion and philosophy [3].

Mind that is discussed in Hegel's logic is abstract and original. In nature, mind changes to its external form so that it's not mind. In the philosophy of spirit, mind returns to its original. There is an incompatibility between reason (logic) and external world that Hegel named it as contradiction spirit. Removing this contradiction and unifying the logic and the nature is the goal of Hegel's system and the foundation of Dialectic method [5].

## **2. The Dialectic**

Dialectic method is the fundamental concept of Hegel's Philosophy. In this method, each idea may have an opposite of idea in itself potentially. For illustration of this method, we employ the first triad of Hegelian logic: Being, Non-being, becoming. Being has non-being in its inward. A thing converts to nothing if its properties have been captured. For example a table without shape, color, rigidity, etc. is indeed nothing, namely, non-being is hidden in being. The idea of the passage is necessary for passing being and non-being to each other. Existence of being and non-being simultaneously in a thing is contradiction that becoming solves it.

These three components are named as thesis, antithesis and synthesis that being is the thesis, non-being is the antithesis and becoming is the synthesis. The synthesis that is produced from this way could be considered as a new judgment (thesis). Therefore, the opposite of the new thesis is generated (antithesis). This contradiction reaches a higher unity (synthesis). This process can be continued for removing contradiction. The Dialectic method is this trend that demonstrated [3,7].

## **3. Hegel's system**

Hegel expanded dialectic method in his theory structure and used it in each part of his philosophy. In fact, each categories of Hegel's philosophy are formed three components of dialectic method. In other word, the logic, the nature and the spirit are as thesis, Anti-thesis and synthesis respectively. The logic passes to the nature, and then the nature becomes the spirit but this process is dialectical, namely, there are some transients between logic and nature that it happens via spirit. The goal of Hegel's philosophy is to decrease the distance between wisdom (logic) and real world (nature) that it's possible using the philosophy of spirit. Due to this goal logic and nature convert to each other.

This trend in each part of Hegel's theory is observable, namely, Hegel engendered the triad, if he wanted to introduce each part. For example, as you can see in above, each category has a triad that follows the dialectical trend. These components and methods composed the Hegel's system [3,5].

## **3. system dynamics**

A system is a collection of parts which are integrated to accomplish a goal, and system thinking is a mindset for understanding how things work. It is a perspective for going beyond events to looking for patterns of behavior. It is the art and science of making reliable inferences about behavior by developing a deep understanding of underlying structure [8]; and system dynamics is a method to enhance understanding of complex systems.

System dynamics first introduced in the Massachusetts Institute of Technology (MIT) during the mid-1950 by Jay Forrester. The concept of the method was to introduce a circular causality for modeling behavior of complex systems. It deals with modeling a process over time, so, time is the main variable in defining a dynamic system. In a dynamic system the feedback process generates the behavior of the system, and time delays in feedback loops affect its behavior [9]. The art of system dynamics modeling is representing the feedback process by means of causal loop diagrams and stock and flow structures.

## 1. Causal loop diagram

Causal loop diagrams (CLDs) are a system thinking tool for representing the feedback structure of systems. These diagrams show how variables in the system affect each other. CLDs are excellent for [10]:

- Quickly capturing your hypotheses about the causes of dynamics;
- Eliciting and capturing the mental models of individuals or teams; and
- Communicating the important feedbacks you believe are responsible for a problem.

In causal loop diagrams, the relation between variables is shown by arrows connecting one variable to another denoting the causal influences among the variables [10]. These arrows can be labeled as positive or negative. Positive relationship refers to 'a condition in which an increase in one variable value responds to the other variable value with a positive increase', and Negative relationship refers to 'a condition in which an increase of one variable value responds to the other variable value with a decrease' [11].

A positive feedback loop is a loop which have an *even* number of negative causal links, and a negative feedback loop is one which have an *odd* number of negative links. Positive feedback loops are also called *reinforcing* loops while negative loops are called *balancing* loops [11]. Reinforcing loops are associated with exponential growth and balancing loops are associated with reaching plateau.

An example of a causal loop diagram is illustrated in figure 1. As shown in figure 1, an increase in population increases the number of birth, and an increase in birth rate increases the overall population, so, this is a reinforcing loop. In the contrary, an increase in population increases the number of deaths, and then the population decrease, so, this is a balancing loop.

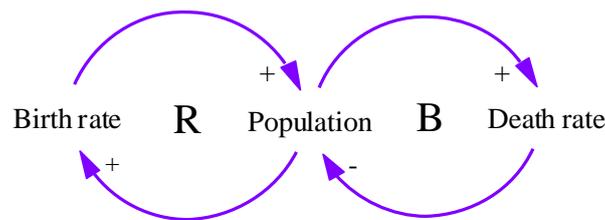


Figure 1: An example of causal loop diagram

## 2. Stock and flows

Stock and flow diagrams are another means for representing the behavior of the system which help you assign equations to the relationships between variables. In Stock and flow diagrams stock is represent the quantity of variable while flows represent the rate of change in inventory [9]. These diagrams provide a general way of representing a process.

A *stock* variable is related to time point and measured at one specific time which may have been accumulated in the past. A *flow* variable is related to time intervals and measured over an interval of time. Therefore a flow would be measured *per unit of time* [9].

In stock and flow diagrams, stock (level) is shown by a rectangle and flow occurs into and out of the level, decision function determine the rate of a flow and acts as a valve in the flow channel. An example of a stock and flow diagram is illustrated in figure 2.

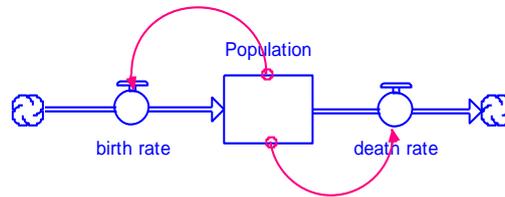


Figure 2: An example of stock and flow diagram

### 3. Patterns of dynamic behavior

In the real world it happens many times that we think a system is in a stable situation but after a while it goes out of control. These dynamic behaviors show the feedback structures generating them. The systems approach deals with similar patterns of behavior show up in a variety of different situations, and the underlying system structures that cause these characteristic patterns.

The most fundamental patterns of behavior are exponential growth, goal seeking, and oscillation [10]. In the following paragraphs we will have a brief review on these patterns of behavior.

*Exponential growth:* Exponential growth is representative of positive feedback loops. In this mode of behavior the larger quantity of variable leads to faster growth and change. In exponential growth an initial quantity of something starts to grow, and the rate of growth increases. The term *exponential* comes from a mathematical model for this increasing growth process [12]. Figure 3 shows an exponential growth diagram.

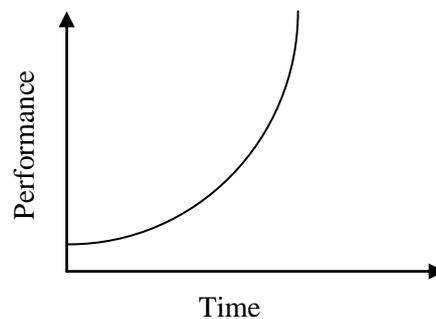


Figure 3: Exponential growth diagram

*Goal seeking:* Negative feedback loops are generators of goal seeking. Goal seeking moves the state of the system to meet the goal and represents how a certain state is managed so as to reach a given goal. In this mode of behavior correction action eliminate any discrepancies between the state of the system and goal. If the current level of the variable is above the goal, then the loop structure pushes its value down, while if the current level is below the goal, the loop structure pushes its value up. Figure 4 shows a goal seeking diagram.

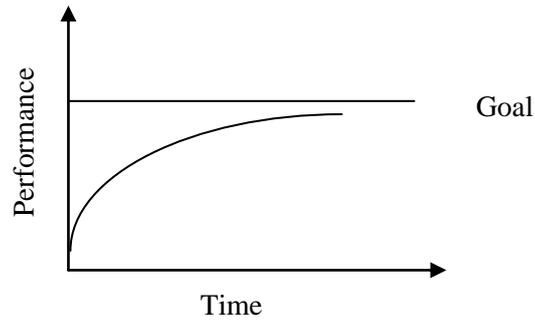


Figure 4: Goal seeking diagram

*Oscillation:* Oscillation is one of the most common modes of behavior in dynamic systems [10]. Oscillation refers to a behavior in which the values of the stocks vary around some average value in a repeating pattern. The same as goal seeking, oscillation is representative of negative feedbacks.

In an oscillatory system, corrective actions are taken to eliminate any discrepancies; but in contrary with goal seeking, in an oscillatory system, the state of the system overshoots and undershoots its goal and so on. This different pattern is the result of a significant delay in part of the negative loop, so the quantity of interest fluctuates around some level and the degree of oscillation is usually impacted by the delays in the process. Figure 5 shows the behavior of an oscillatory system.

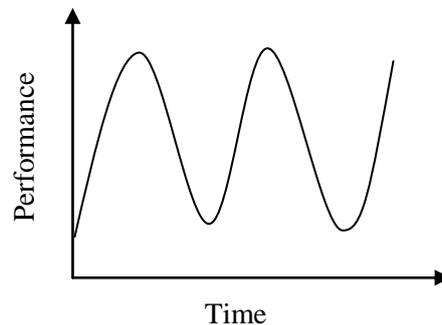


Figure 5: Oscillatory system diagram

There are different types of oscillation such as, damped oscillations, limit cycles, and chaos. In the real world many oscillations are damped oscillation [10].

Damped oscillations behavior is essentially a combination of oscillations behavior and asymptotic behavior [11]. In damped oscillation, the state of the system oscillates around the goal and the gap between the equilibrium and stock value decreases, gradually. The behavior of a damped oscillatory system is illustrated in figure 6.

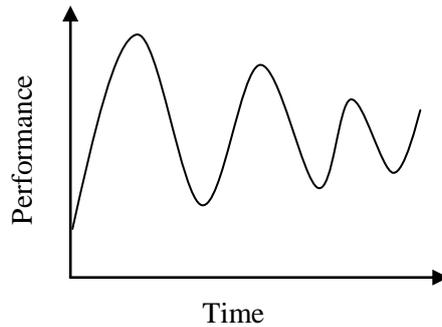


Figure 6: Damped oscillatory system diagram

#### 4. Similarity between Hegel's philosophy and System dynamics

Hegel tried to summarize the previous philosophies and dig up the components and relationship between them, indeed system thinking is employed to interpret philosophical theories. In Hegel's system, the categories are not considered as separate and isolated and they are even influenced by each other. Hegel divided the whole to parts and components and established a method to explain the relations. In this system, the first simple terms are used for understanding the complex succeeding terms.

##### 1. Comparing the Hegelian philosophy with damped oscillation pattern

The pattern of Hegelian dialectic is similar to the behavior of damped oscillatory systems. As shown in figure 7, when a new thesis is generated, after a while an antithesis which opposes to the current thesis will be generated in the lower level. The conflict of thesis and antithesis will generate synthesis that is less excessive than the current thesis and antithesis, so the synthesis will be situated between thesis and antithesis in diagram. The generated synthesis indeed is the new thesis. This process continues till there is no antithesis generated.

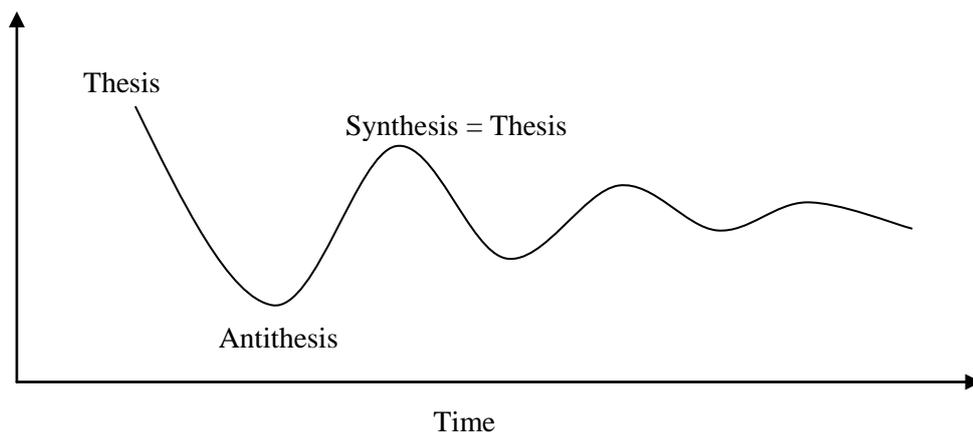


Figure 7: The oscillation pattern of Hegelian dialectic

##### 2. Defining the Hegelian philosophy with causal loop diagrams

In the Hegelian philosophy, the relationship between thesis, antithesis and synthesis can be illustrated as a causal loop diagram. This relationship is shown in figure 8.

The connection between thesis and antithesis is negative; when the level of thesis is high, it causes the lower antithesis to be generated. If we consider a thesis as a stock and assume that the current thesis occupies high level of stock, then antithesis as opposed to the current thesis will occupy a low level of stock. So, we can consider the relationship between thesis and antithesis as a negative relationship. In the contrary, the relationship between antithesis and synthesis is positive; when the antithesis is in a low level, it results in the synthesis that has a lower level than the preceding thesis. As a result, the lower antithesis pushes the synthesis to the lower level, so the relationship between the antithesis and the synthesis is positive. A synthesis can be considered as a new thesis, so, we can conclude that the impact of synthesis on thesis is positive and the arrow which has connected synthesis to thesis should be labeled as positive relationship.

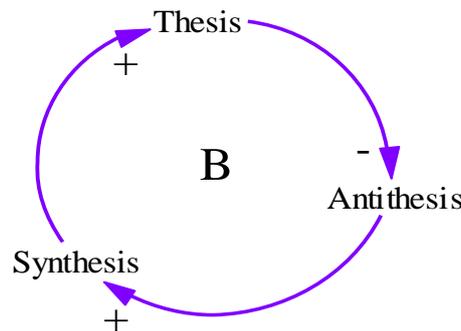


Figure 8: The causal loop diagram of Hegelian dialectic

## 5. System dynamics model

In this section, we try to illustrate the Hegel's system by using an example and make a system dynamics model for this sample. This example is from Sophie's World book [14]. In this book, the Hegel's dialectic method is employed to show how different philosophical theories are emerged. When a new theory (thesis) is announced, after a period another theory against the first theory (antithesis) is revealed, therefore, in future a new theory will be made that is medial and has good points from the two others (synthesis). This trend continues while there is no antithesis. For example, contrast between rationalism and attitude to experience, Descartes in his philosophy focused on reason and rational support, but Hume considered to value of experience, so that he discarded rational analyses and concentrated on experimental results. As a result of these two viewpoints, Kant revealed his theory that was an intermediate theory and includes the two others.

We make system dynamics model for this example, so that it can simulate the trend of the theory's alteration. This model is shown in figure 9.

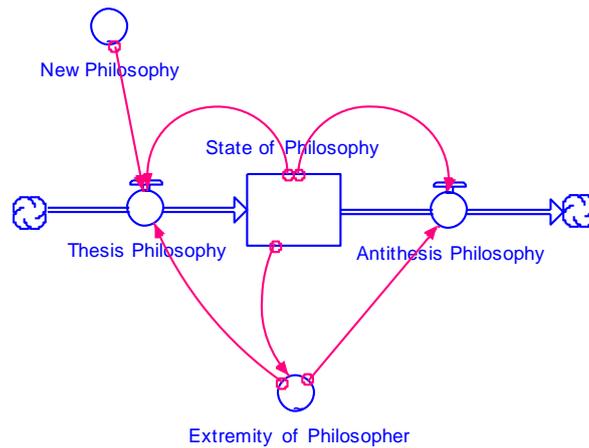


Figure 9: System dynamics model for state of philosophy

In this model, a new philosophy is emerged, so the state of the philosophy pushes to the thesis. Due to there is delay to generate an antithesis, current philosophy tends to reinforce the new philosophy. According to the extremity of state of philosophy, antithesis emerges. The antithesis will be more severe, if the severity of the thesis be more. This adjustment applies by the variable of extremity of philosopher, namely, this variable inbreed the severe antithesis when the intensity of the thesis in the state of philosophy is high and vice versa. After the delay of antithesis, the philosophers that are the admirers of the thesis try to bring a new synthesis that it causes a new antithesis. These interplays are continued in so far as there is no antithesis. Therefore, the system comes to balance at the goal of the philosophy. The output of the model is exhibited in figure 10, this figure shows the oscillation mode of the state of philosophy that conforms to the dialectic method.

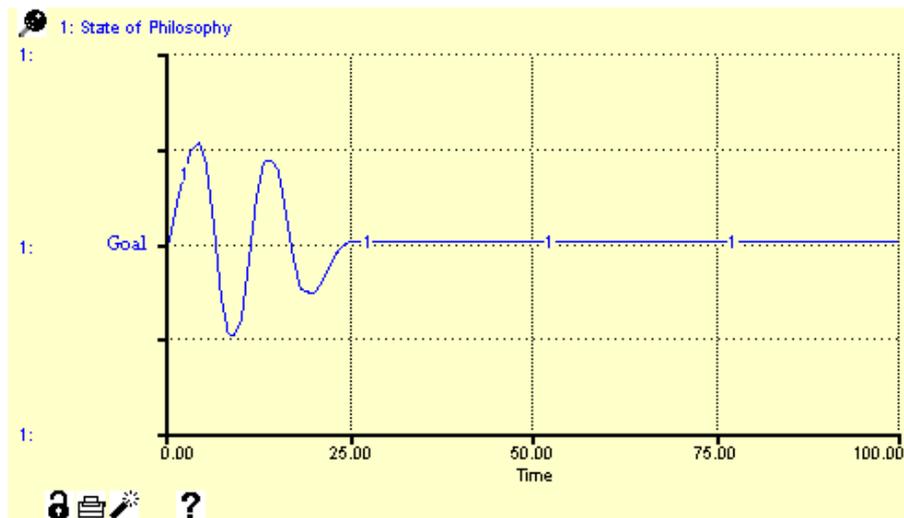


Figure 10: The output of the model

As you can see, the system would be balanced when there is no antithesis for the last philosophy (synthesis). It must be mentioned that our purpose in modeling the Hegelian philosophy is to simulate this theory via the system dynamics tools. The equations of this model are listed in table 1.

Table 1: Equations for stock and flow diagrams

(1)	Initial (State of philosophy) = no philosophy
(2)	Thesis philosopher = DELAY(IF(State_of_Philosophy<Goal) THEN(Extremity_of_Philosopher*ABS(State_of_Philosophy-Goal)) ELSE(0),2,1) + New_Philosophy
(3)	Antithesis philosopher = DELAY(IF(State_of_Philosophy>Goal) THEN(Extremity_of_Philosopher*ABS(State_of_Philosophy-Goal)) ELSE(0),2,1)
(4)	Extremity of philosopher = Graphical function that has an output (0,0.9)
(5)	New philosophy = Graphical function that works as a pulse, its time is equal to emergence of new philosophy

## 6. Conclusion

The aim of this paper is to highlight the similarities between Hegel's philosophy and system dynamics, and in doing so, use the casual loop diagram to interpret the dialectic method. In addition, the stock and flow model is employed to simulate the procedure of Hegel's philosophy. As a result, we show an oscillatory trend with delay in Hegelian method via this model. Future works will focus on using more accurate empirical data on how can interpret Hegel's theory. Besides, this article can be as a basis for new roadmap of MIT system dynamics in education project, so that the system dynamics can be more understandable for philosophy students.

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