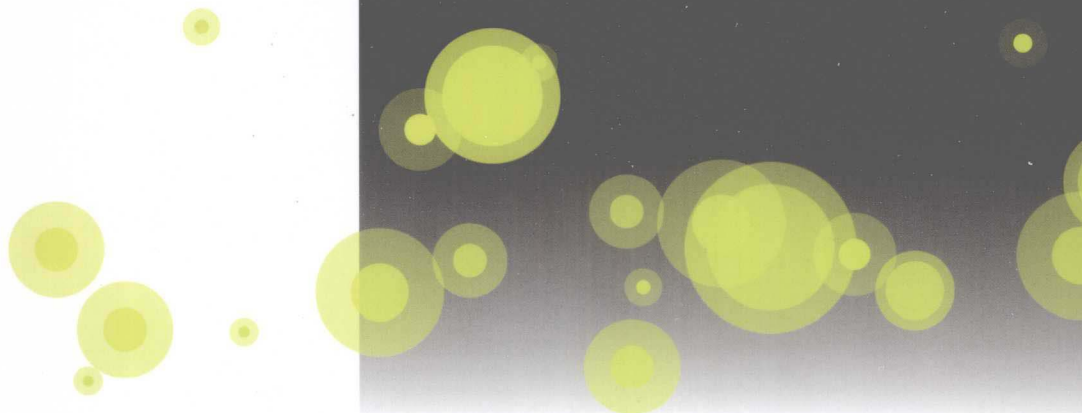




# Introduction to Grey Mathematical Resource Science

■ Deng Julong



华中科技大学出版社  
Huazhong University of Science & Technology Press

# **Introduction to Grey Mathematical Resource Science**

Deng Julong

Huazhong University of Science and Technology Press  
• Wuhan •

图书在版编目(CIP)数据

Introduction to Grey Mathematical Resource Science(灰色数理资源科学导论):英文/Deng Julong(邓聚龙).—武汉:华中科技大学出版社,2010年5月

ISBN 978-7-5609-6184-2

I.I… II.D… III.灰色系统-系统理论-英文 IV.N94

中国版本图书馆CIP数据核字(2010)第080793号

**Introduction to Grey Mathematical  
Resource Science**  
(灰色数理资源科学导论)

Deng Julong  
(邓聚龙)

责任编辑:姜新祺

封面设计:潘群

责任校对:朱霞

责任监印:熊庆玉

出版发行:华中科技大学出版社(中国·武汉)

武昌喻家山 邮编:430074 电话:(027)87557437

录排:武汉佳年华科技有限公司

印刷:湖北恒泰印务有限公司

开本:710mm×1000mm 1/16

印张:11.5

字数:200 000

版次:2010年5月第1版

印次:2010年5月第1次印刷

ISBN 978-7-5609-6184-2/N·25

定价:36.00元

(本书若有印装质量问题,请向出版社发行部调换)

# PREFACE

Let “Mathematical Resource Science” be an amalgamation, thus “Grey Mathematical” and “Grey Mathematical Resource Science” connotes their two subsets.

“Mathematical Resource” connotes the model, algorithms, theorems, laws, conceptions possessing values of resource in mathematic, physic, and grey theory.

We call resource existing mechanism, and resource distinction the resource biology (or biology for short). We thus say biology is the must for every resource.

Accordingly, there are life biology, mathematical biology, society biology, and information biology, owing to the cardinal purpose for resource studying is to exploiting and utilizing resources. Thus the exploiting mathematical resource connotes to exploit its existing mechanism and distinctions.

In CHAPTER 1: Ideology exploiting. The phenomenon leads to conception. The exploiting ideology concluded from the phenomenon in resource existing mechanism, attributes, sorted league connotes the conception exploiting, though it is notion only. However, it is the prerequisite of utter exploiting.

In CHAPTER 2: The biology exploiting of social resource. The social behavior factors connote the biology factors of society by means of ordering biology factors to promote the global efficacy is resource integrating. The integrating courses behave as ordering effectiveness

notion. The integrating course after mathematization of biology factors, evince as GM(1, N) modeling.

In CHAPTER 3: Programming exploiting. While attain exploiting is not by means of changing the existing mechanism and distinction of resource, exploiting achieve by means of reasonable utilizing and scientifically allocate is programming exploiting. All of those does not refer to input exploiting, but is the essentially nil-material-input exploiting.

In CHAPTER 4: Life resource biology exploiting. It is the exploiting for the natural existing mechanism and the natural distinction of life.

In CHAPTER 5: Grey mathematical biology exploiting. The resources having comparable distinction connotes the convex quality one, else, is the concave quality one like mineral deposits hiding in the earth deeply. The sci-tech resource has not to be integrated or has not to be assessed yet, refer to concave quality.

For concave quality resources, it is necessary to evaluate the quality via grey target analysis, grey statistics or grey clustering etc. before exploiting.

In CHAPTER 6: Information resource biology exploiting. The information is said to be immediate effectiveness (IEFF), provided that it possesses time-efficiency in efficiency-wealth S curve. The IEFF information connotes information resource, like the information of national economic resources, the information of region sci-tech resource, and the information of Chinese herbal medicine, all of these refer to IEFF information, information resource.

While the book *Introduction to Grey Mathematical Resources Science* publishing, I wish to express my sincere appreciation to HUST

PRESS, in terms of exploit novel discipline's resources making decision publish this book.

I also express my sincere appreciation to Mr. Jiang Xinqi, he concerning the book's publication and contribute many hard work and many wits in very busy status.

*Deng Julong*

# CONTENT

<b>Introduction to Grey Mathematical Theory</b> .....	(1)
<b>Chapter 1 Conception Exploiting</b> .....	(9)
1.1 Conception on Grey Resources .....	(9)
1.2 Properties on Grey Resources—— Economic-Technical Properties .....	(10)
1.3 Categories on Grey Resources .....	(12)
1.4 Efficacy-Wealth Co-Survival Model; S Model .....	(14)
1.5 Grey Hazy Set on Resource Efficacy Forming .....	(17)
<b>Chapter 2 The Ecology Exploitation of Social Resource</b> .....	(19)
2.1 Ordering Effectiveness Concept of Grey Resource .....	(19)
2.2 Ordering Effectiveness in GM(1, N) .....	(20)
2.3 GM(1, N) Integrating Concept .....	(21)
2.4 GM(1, N) Integrating Criterion on Resource Optimal Integrating .....	(22)
2.5 Instance of Ecology Exploiting on Social Resource .....	(25)
2.5.1 Resource background .....	(25)
2.5.2 Behavior resource series LHK urban resource optimum integrating planning .....	(26)
2.5.3 Component integrating .....	(27)
<b>Chapter 3 Programming Exploitation</b> .....	(37)
3.1 Outline on Programming Exploitation .....	(37)
3.2 Grey Linear Programming with Thrift Resources .....	(43)
3.2.1 Notations .....	(43)
3.2.2 Grey league space .....	(44)
3.2.3 Thrift resource grey linear programming .....	(46)
3.2.4 Calculating example on SRGLP .....	(48)
3.3 Ergodic Sparing Resource Grey Linear Programming .....	(50)

· II · Introduction to Grey Mathematical Resource Science

3.3.1	Goal on programming	(50)
3.3.2	Notations	(50)
3.3.3	ERSRGLP calculating	(51)
3.4	Thrift Resource Situation Programming on Components	(53)
3.4.1	GLLERP	(53)
3.4.2	Thrift of resource grey situation linear programming of components	(56)
3.4.3	Principle and calculation on replacement of components in value engineering	(59)
3.5	Thrift of Resources Time Domain Situation Grey Programming	(59)
3.6	Thrift of Resource Situation Programming in Time Domain for Total Ration Limit	(62)
<b>Chapter 4</b>	<b>Biology Exploitation of Life Resource</b>	(71)
4.1	Outline on Life Resource Exploitation	(71)
4.2	GRA Breeding Target Character	(72)
4.3	The Selection of Optimal Region for Breeding	(74)
4.4	Parent Sorting via GRA	(77)
4.5	Quality Analysis for Gluctenin Subunit of High-Quality Wheat	(83)
4.6	Life Prophylaxis(Biology Relationship With Grey Numbers)	(87)
4.7	Grey Differential Model of Animal Living & Exercising Relation	(90)
<b>Chapter 5</b>	<b>Biology Exploitation of Grey Mathematical Resources</b>	(98)
5.1	Outline on Biology Exploitation of GMR	(98)
5.2	Steep GM(1,1)	(98)
5.3	GM Modeling in Resource Efficacy Space	(101)
5.3.1	Essence set	(101)
5.3.2	Axioms and definitions	(102)
5.4	Mineral Resource Exploiting(Grey Trap)	(105)



5.4.1	Grey trap concept .....	(106)
5.4.2	Simulation calculation of grey trap .....	(107)
5.5	Grey Assessment in Resource Efficacy Field .....	(111)
5.5.1	Outline .....	(111)
5.5.2	W-abstract .....	(111)
5.5.3	Both synthesis in assessed .....	(111)
5.5.4	Data matrix .....	(111)
5.5.5	Laws of label body .....	(112)
5.5.6	Grey statistic .....	(113)
5.5.7	Calculating example for statistic assessment .....	(113)
<b>Chapter 6</b>	<b>Biology Exploiting of Information Resources</b> .....	(117)
6.1	National Economic Information Resource( Resource Block) .....	(117)
6.1.1	Definition on sub-block <i>B</i> .....	(117)
6.1.2	Resource mode .....	(121)
6.1.3	Resource modes ordering .....	(122)
6.2	Ore Resource Exploiting Situation Prediction .....	(123)
6.3	Spring Resource Prediction .....	(126)
6.4	Flow Prediction in Flood Season of River .....	(130)
6.5	Prediction of Exploiting Situation for Reservoir Resource .....	(135)
6.6	Chinese Herbal Medicine Resource .....	(138)
6.6.1	Table Element( TE) .....	(138)
6.6.2	Chinese herbal medicine-comparison of life mass spectrum and ionizing-tech by table element .....	(141)
6.6.3	GRA on indicators of hypertension .....	(144)
6.6.4	TE on A & DK( analyzing & differentiating kenning) model and A & DK knowledge in TCMS( traditional Chinese medicine science) .....	(158)
6.6.5	TE on life resource in Chinese herbal medicine .....	(163)

# Introduction to Grey Mathematical Theory

The Chinese founder of comprehensively investigating resource Prof. Zhu Kezhen points out; it is necessary that natural science should cooperate with social science for investigating resource science comprehensively.

The scholars in international community of grey theory, count grey theory the mathematical science, such as Japanese scholar: 永井正武 professor of Japanese University of 帝京, in his monograph わかる灰色理論と工学応用方法入門 (共立出版, 2004, October) in postscript OUTLINE on grey theory “灰色分析と灰色理論の誕生” mentioned: 灰色理論は, 1982 年じ鄧聚龍 (professor of Huazhong University of Science & Technology) じよって提案された比較的新しい数理理論である.

In China, a few scholars count grey theory as a part of mathematical science and maintain that the system of grey mathematical sciences connotes the amalgamation, which comprises grey system science, grey resource science and grey information sciences.

In terms of the notion on resource sciences, mathematical resource sciences contain “grey mathematics” and “grey mathematical resource science”.

The so-called grey mathematical resource connotes the model, algorithms, laws, theorem notions possessing the value of resource in mathematics, physics ... and grey theory especially for those characterized by having ability of exploiting, socializing. The socializing ex-

amples are as follows :

- The 1st pan-Newton's Law The existing disturbed force is the sole evidence to change the behavior track.

- The 2nd Pan-Newton's Law The inert strength of crowd behaves as bearing extent for disturbed force.

- The 3rd Pan-Newton's Law Self-defense law; crowd after bear disturbance force, there sure are anti-disturbed force equalizing strength in size of force and opposite in direction of force.

It is a great diversity of topics. However, among those crowd is the one of great uncertainty, the one of rich resource. Thus society resource formed by crowd is the cardinal topic in grey mathematical resource. Actually, the so-called distinct resources integrating being sore to be on integrating by utilizing social resource as pillar, such that social resource connotes the pillar in mathematical resource science.

Energy assembling connotes the core of social resource. In terms of energy assembling that social energy differs from the general energy. Former assembling implies gathering the human's idea and thought, willing and wishing.

According to exploiting resource notion, the action and behavior of crowds relate to social-mechanics.

### **1. Social gathering energy space**

Let  $\mathcal{N}$  be set of pan-Newton's law.  $\sigma^{(1)}$  be assembling element of energy. Thus  $(\mathcal{N}, \sigma^{(1)})$  is said to be assembling energy space provided that

1° possessing notional assembling energy nature; (Ortiz nature);

2° having intellectual energy nature;

3° exploitability in social biology.

$(\mathcal{N}, \sigma^{(1)})$  connotes behavior terrace for social energy (education...) and value terrace also.

The connotation of resource value include that

- ① exploiting value in economic (economical notion);
- ② theoretical value in disciplines (soft value notion);
- ③ utilize ability by person and nation (utilizing notion);
- ④ investigating value in technology (technical notion);
- ⑤ in rare finding (precious notion).

$(\mathcal{N}, \sigma^{(1)})$  connotes notion terrace.

The connotation of notions include that

① exploiting resource notion, the resource efficacy can be exploited and being exploited is a must. For example, the laborers is said to be laborious resources provided that their quality and technique can be promoted by education or training.

② utilizing resource notion, the resource efficacy can be utilized and being utilized is a must. For example, the laborers or peasant laborer is said to be social resource, provided that they can be utilized for bring about a great advance in industrial and agricultural production, else, they are not, the grey model  $GM(1, 1)$  is said to be important resource in grey theory. Due to by which we can obtain accurate predicted results, and which can be used as an available analyzing means.

③ resource integrating notion. The resources with distinct quality being said to be mathematical resource provided that which can be promoted efficacy by integrating, else, they aren't. For example, human resource is essential resource in utter of resources, whether industrial resource or agriculture resource are said to be favorable resource

provided that which can be integrated by human resources.

④ resource quality notion; resource connotes the carrier of efficacy. Thus, RQN (resource quality notion) implies efficacy notion and carrier notion. For example, the object is reputed as resource provided which possess certain actual efficacy, else, it is not. In disciplinary resource only these model, algorithms having higher analyzing efficacy or assessing efficacy can be reputed as disciplinary resource, else, they aren't.

## 2. Social energy

The energy evincing in crowd contribute to society progress is reputed as society energy.

The essential purpose studying social energy connotes to know the abstract process gathering energy and provide harmoniously environment for mathematical biology exploiting.

The Orlicz space provides on rave terrace for notionally gathering energy, owing to their convexity and assemblies.

Orlicz space refers to branch of functional, it studies a genus of functional space, which is more generalizing than the well-known functional on  $L$ , which provides functional with an intuitive background and also an rave terrace for grey energy gathering.

This subject raise in the 1930s, founded in the end 1950s.

The book *Convex function & Orlicz Space* by A · Красюсеивский & ЯБРУТЛПКуи connotes their representative work. Prof. Wu Congxin is the representative scholar in China.

The  $N$  function, which generated Orlicz space, in symbol  $M(U)$  possess the following properties:

$$1^\circ M(0) = 0;$$

2° when  $U > 0, M(U) > 0$ ;

$$3^\circ \lim_{U \rightarrow 0} \frac{M(U)}{U} = 0; \lim_{U \rightarrow \infty} \frac{M(U)}{U} = \infty.$$

The function  $P$ , as a core of  $M(U)$  possessing following natures:

1°  $p(U)$  is continuity from the right and decreasing;

2°  $U > 0, p(U) > 0$ ;

3°  $p(0) = 0, p(\infty) = \infty$ ;

$$4^\circ M(U) = \int_0^{t \in T} p(t) dt.$$

Let  $p_{OL}(p)$  be polar of  $p$  function, the utter of  $p_{OL}(p)$  is denoted as  $P$ ,  $p_{OL}(M)$  be polar of  $M$  function, the utter of  $p_{OL}(M)$  is  $M$ . Thus, mapping  $P \rightarrow M$  is gathering energy, mapping  $M \rightarrow P$  is divergent mapping.

• Gathering energy transformation  $\mathfrak{E}$  is said to be transformation gathering energy, provided that

$$1^\circ \mathfrak{E} : P \rightarrow M; \mathfrak{E}^{-1} M \rightarrow P;$$

$$2^\circ \mathfrak{E} (x^{(0)}) = x^{(1)} = \sigma;$$

$$3^\circ p_{OL}(x^{(0)}) = p_{OL}(F) \text{ fore polar};$$

$$4^\circ p_{OL}(x^{(1)}) = p_{OL}(\sigma) = p_{OL}(W) \text{ energy polar.}$$

• Notional force transformation (NFT)  $\mathcal{F}$  is said to be NFT in  $\mathcal{N}$ , provided that

$$1^\circ \mathcal{F}(\sigma) = \sigma / \&, p_{OL}(\sigma / \&) = p_{OL}(F);$$

2°  $p_{OL}(\&) = p_{OL}(S)$ ,  $\&$  is the notional displacement,  $S$  is the discrete displacement.

• Interleaved stress equilibrium principle (ISEP) According to ordering mechanism in mathematical biology,  $x^{(0)}(k)$  can be ranking as

$$x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(k-1), x^{(0)}(k).$$

We call  $\sigma^{(1)} - x^{(0)}(k)$  the left stress, in symbol LS, provided that

$$p_{OL}(\sigma^{(1)} - x^{(0)}(k)) = p_{OL}(F);$$

$\sigma^{(1)} - x^{(0)}(k-1)$  the right stress, in symbol RS, provided that

$$p_{OL}(\sigma^{(1)} - x^{(0)}(k-1)) = p_{OL}(F).$$

We call  $-\sigma^{(1)} - x^{(1)}(k-1)$  the negative LS(NLS), there thus are ISEP

$$FS = NLS,$$

$$\sigma^{(1)} - x^{(1)}(k) = -\sigma^{(1)} - x^{(1)}(k-1).$$

SEP(stress equilibrium principle)

$$FS = -LS,$$

$$\sigma^{(1)} - x^{(1)}(k) = -(\sigma^{(1)} - x^{(1)}(k-1)).$$

### 3. Intellectual energy

As social energy gathering connotes assembling willing notion, wishing, the gathering implies intellectual energy gathering.

The cardinal distinction of intellectual energy behave as information issuing or responding.

• Issuing unit Let  $\Sigma + \eta_i$  be volume issuing order by information carrier  $a_i$ , and  $\Sigma - \eta_i$  be volume receiving order by carrier  $a_i$ . We thus call  $a_i$  the issuing unit, provided that

$$1^\circ \Sigma + \eta_i > \Sigma - \eta_i;$$

2° existing one responding unit at least.

The carrier  $a_j$  is said to be responding unit, provided that

$$1^\circ \Sigma + \eta_j < \Sigma - \eta_j;$$

2° having responding willing.

• Information chain Let  $+\tau$  be issuing unit,  $-\tau$  responding unit,  $\tau$  the arbitrary unit,  $\tau^*$  the responding action unit. Then the in

formation chain set  $\Lambda$  is said to be information chain, provided that

$$1^\circ \Lambda = \{ +\tau, -\tau, \tau, \tau^* \};$$

2° the adjacent relation in  $\Lambda$  is essentially the chain relation.

• Closed chain It is said that the elements  $x$  in  $\Lambda$ , form a closed chain provided that

$$1^\circ \text{ chain formation } +\tau \rightarrow \tau \cdots \tau \rightarrow -\tau;$$

2° responding unit locate as end.

• Open chain The element  $x$  in  $\Lambda$  is said forming an open chain provided that

$$1^\circ \text{ chain formation is } +\tau \rightarrow \tau \cdots \tau \rightarrow +\tau;$$

2° issuing unit locate as end.

• Action chain

$$1^\circ \text{ Chain formation } +\tau \rightarrow \tau \cdots \tau \rightarrow \tau^*;$$

2° Action unit locate as end.

The “openness”, “closeness”, “unions”, “intersections” refer to topological attribute. Here, we will form an intellectual information topology, as a terrace, for developing, delivering, handling intellectual formation.

The course on exploiting mathematical biology, is essentially a course, issuing society demand information and excusing society demand information. The close-base information topology is just existing as such a terrace.

• Definition of close-base in formation topology Let  $X$  be an intellectual information set,  $A$  be arbitrary subset in  $X$ ,  $\bar{A}$  be closed set (executive) of  $A$ . Thus we call  $X$  the close-base information topology (CBIT), provided that

$$1^\circ A \subset \bar{A} \text{ (execution ability);}$$

$$2^\circ \overline{A \cup B} = \bar{A} \cup \bar{B} \text{ (party execution ability);}$$



3°  $\bar{\bar{A}} = \bar{A}$  (non-repeat execution ability) ;

4°  $\overline{\emptyset} = \emptyset$  (carrier nature of executive instruction) ;

5°  $x \in X$  is said to be information resource , provided that

(i)  $X \subset \text{CBIT}$ , and equipped with the natures of resource-efficacy

$S$  curve in  $p_1(o)$  and  $p_2(d)$  (time-efficacy nature) ;

(ii) Conditions of CBIT are reputed as information biology.