孪生素数根系理论与孪生素数猜想

Radical System Theory of Twin Prime Numbers and Hypothesis of Twin Prime Numbers

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【内容简介】 本书以集合论为基础，对素数的宏观分布规律作了较为深入的研究后，又在集合论、概率论及代数方程的基础上，运用狄氏定理和同余理论对：(1)孪生素数猜想，(2)每个正偶数是否都是两个素数之差，(3)每个正偶数是否都能够表示成为无限多对两个素数之差等几个驰名中外的难题，提出了根系理论。

根系理论于1996年提出，根系理论的数学模型在2000年9月的《航空计算技术》上发表。本书分理论部分和孪生素数数据两大部分。数据又分为基础数据和超大数据两部分。基础数据，从自然数1至20亿之间，一个不漏的将所有的孪生素数对全部找出，将基础数据的万分之一刊于书后。对超大数据，50位至2003位亦放在本书之中。

【Brief introduction to the content】 On the basis of set theory, the writer, after a deeper research for the macroscopical distributing law of prime numbers, has again put forward the radical system theory on the basis of set theory, probability theory and algebra equation, which has done with Direchlet theorem and congruent theory used for the conundrums well-known home and abroad such as (1) Hypothesis of twin prime numbers (2) For every positive even number, are they composed of the difference from the two prime numbers? (3) For every positive even number, can they be all expressed as the difference from the two prime numbers of infinite pairs?

In 1996, the radical system theory was proposed, whose mathematic model was published on the magazine *Aero-Calculation Technology* in Sept. 2000. The book has been divided into two parts: one is for theory and the other for data of twin prime numbers. The data has again been divided into two parts, that is, basic data and ultra-great data. With the basic data, from 1 to 2 billion, all twin prime couples may be found out without leaving out. The book just presents one ten-thousendth of the basic data. For the ultra-great data from digit 50 to that of 2003, they have been listed in the book for the moment.

序　言

数论是一门很古老的学科，它有几千年的历史，自然数产生于史前时代，甚至更早一个时期。人类对自然数的认识、研究、利用源远流长。

人类社会处在蛮荒时代时，为了生存就必须和大自然进行抗争，把采集得来的野果和捕猎得来的猎物要进行分配，首先接触到的就是自然数。

而数论就是研究整数及其性质的一门学科，在历史发展的漫长历程中，简单的数学开始慢慢形成，与此同时，数论这一数学分支的雏形，亦孕育其中。

数论，它和数学的发展是密不可分的，它是一门很古老的学问，我国古代数学专著《周髀算经》中，也有数论问题的记载。数论中一些驰名中外的难题，数百年来，常胜不衰，它具有无穷的魅力，吸引着世界一流的数学家，亦吸引着数学爱好者。一个数论难题给一个普通人用几分钟的时间就可以讲清楚，但要证明它却是非常之难。

几个世纪过去了，国内外数以百计的科学家和千万计的数学爱好者，耗尽了毕生的精力乃至生命，向这些难题构筑的“堡垒”进军，而迄今，有一些“堡垒”仍然没有被攻破，仍然巍然不动，但时间却一天天过去。

挪威数学家布朗把相差为 2 的一对素数称为孪生（双生）素数，这个名词一直沿用至今。

1900年，在法国巴黎召开的国际数学大会上，德国大数学家希尔伯特提出了23个问题，这23个问题，希尔伯特认为是最重要的问题，它代表20世纪数学发展的方向。

其中第八个问题，包括：黎曼猜想，哥德巴赫猜想及孪生素数猜想。

其后，美国数学家阿普斯托尔，在他的著作中，收集到关于素数分布的12个问题，其中之一就是：任意大于2的偶数是否可表示为两个素数之差。

以上这些难题，迄今都未获解决。我国数学家在数论的研究上取得了举世瞩目的成就。一个数学家对数论中未获解决的难题，只能作出一种选择；要么证明它，要么推翻它，二者必择其一。

数学的本质，就是如何发现定理及怎样证明定理？而数学家所作的重要工作是利用新概念、新方法，运用逻辑思维来证明自己的发现是正确的。

从数论发展历史来看，数论中一些重大难题的解决，都用到一些新概念，新的数学模型。

新概念的发现是数学史上的里程碑。

近一个世纪以来，解析数论得到迅猛的发展，它建立了各种数学模型，研究这些数学模型，以揭示素数的一些特征和分布规律，这就使得解析数论成为最活跃的数学分支之一。在对素数宏观规律的研究中，在集合论、方程理论、概率论的基础上提出根系理论。

定理：孪生素数存在于根系之中。

根系理论的意义在于：

其一：根系它反映出孪生素数的分布规律。其二：根系揭示出素数的堆状分布规律。

根系之用途有以下几点：

(1) 根系可以判断任意一对自然数是否为孪生素数。

(2) 根系可以计算出任意位的孪生素数。(指当代的计算机能计算出的最大位数)

(3) 由根系理论,可以构造出《孪生素数生成表》

(4) 用根系概念,可将孪生素数分类,即:孪生素数只能分成三大类。

关于部分超大孪生素数的计算情况:

(1) 1999 年 7 月在成都科学院,把孪生素数计算到 50 位、60 位、70 位、80 位、90 位、100 位、140 位、150 位、200 位、302 位。

(2) 1999 年 9 月在甘肃联合大学长庆分校,把孪生素数计算到 422 位,543 位,606 位,726 位。

(3) 2000 年 5 月在长庆物探公司计算中心,把孪生素数计算到 750 位,801 位(三对),1002 位(五对)

(4) 2000 年 6 月 23 日在长庆物探公司计算中心,把孪生素数计算到 2003 位(两对,其值附后)。

本书在写作过程中,得到长庆石油勘探局的领导孙玉辰、冯尚存、曹师伊的关心和照顾。甘肃联合大学长庆分校的领导史仲乾、余连成、张文锦在本书成稿过程中给了大力的支持,特别是史仲乾在我写作过程中给了很大的支持和帮助。在孪生素数的计算过程中,成都科学院的曾振柄、王若峰给予热情的帮助和指导,中国航空计算技术研究所宋增浩和陕西科技大学李德志,西安现代非线性科学应用研究所阎坤和西安交通大学黄艾香,以上这些专家、教授在我的研究工作中,给予很大的支持和指导。特别是在超大孪生素数的计算过程中,长庆物探公司计算中心项发、钱俊生,钻井公司曹湘华给予大力支持和热情合作。在孪生素数的寻找和材料的校对上,项发作了大量的工作,本书在写作过程中得到了 30 多

位专家和同行的指导。西北工业大学出版社的领导和编辑在本书出版过程中给予了大力的支持和帮助，作者在此一并深致谢忱。

限于作者水平，书文如有不妥之处，请批评指正。

杨茂祥

2003 年 5 月

PROLOGUE

Number Theory is an ancient subject with thousands of years and natural number came into exist before the written history, or even in a period earlier than that of the written history. It is of long standing that the human being originate, study and make use of the natural number.

When the society of human being was going during the uncivilized age, people have to oppose against the nature for existing and to distribute the collected wild fruit and hunted quarry, the natural number was firstly originated by the people.

Number Theory is a subject for studying integer and its property. In the long history, the *Simple Mathematics* was gradually shaping and at the same time, the *Number Theory*, as a rudiment of the mathematics branch was also developing.

Number Theory cannot develop without mathematics. It is an ancient knowledge and in the *Mathematics Sutra of Zhou Dynasty*, an ancient mathematics monograph of China, there were some records about number theory. Some conundrums in the *Number Theory* well-known home and abroad have been attracting the first-rate mathematicians in the world and also the mathematics fans. With just a few minutes, a conundrum in the number theory can be made clear for ordinary people but to prove it is very, very difficult.

A few centuries have passed and hundreds of scientists and thousands of mathematics fans home and abroad have been marching on at the "fortresses" structured by the conundrums with all their lives. And by now, some of the "fortresses" are still unbroken while time is lapsing day by day. Brown, a Norway mathematician called the pair of prime number with difference of 2 twin prime number and the term is used until today.

In 1900, on the international mathematics conference held in Paris, Hilbert the German mathematics master had proposed 23 questions and the mathematics master took them as the most important questions representing the direction of mathematics development in the 20th century.

The 8th question of the 23 questions proposed by Hilbert includes: Rieman Hypothesis, Goldbach Hypothesis and Hypothesis of twin prime number.

Later, with his books, Arpustuoer an American mathematician, has collected 12 questions about the distribution of prime number and one of them is: may any of even numbers greater than 2 be the difference from two prime numbers. All the above conundrums have not been resolved yet. And the mathematicians of China have got striking achievements in the range of number theory study, which are focused by the world. For the conundrmns in number theory not resolved yet, a mathematician has to make one choice only, to prove it or deny it. Double-talking about it will not do.

The essence of mathematics is how to discover theorem and how to prove it while the important work for a mathematician to

do is to make use of new concept, new method and logic thinking for proving that the discovery by himself is correct.

In the view of the development history of number theory, some new concepts and mathematics models have, without exception, been used for resolving the key problems in the number theory.

Discovery of new concepts is a milestone in mathematics history. For nearly a century, analytic number theory has greatly developed with various mathematics models set up. And to study the models is to open out some characteristics and distribution law of prime number, which has made the analytic number theory one of the most active branches of mathematics. In the research of the microscopical law of prime number, the radical system theory has been put forward on the basis of set theory, equation theory and probability theory.

Theorem: Twin prime numbers have existed in radical system.

The significance of radical system theory is:

Firstly, the radical system theory has shown the distribution law of twin prime number and secondly, it has opened out the heap-sort distribution law of prime number.

The use of radical system may be for:

(1) The radical system may be used to make it certain that if any pair of natural number is twin prime number.

(2) The radical system may be used to make out any twin prime number (the greatest digit calculated by the modern computer).

(3) With radical system theory, *Generating Table of Twin*

Prime Number may be framed.

(4) With the concept of radical system theory, twin prime number may be classified into three sorts (only three, no more).

The following is about the calculation situation about some of the ultra-great twin prime number:

(1) In Chengdu Science Academy in July 1999, twin prime numbers had been calculated up to the digit 50, 60, 70, 80, 90, 100, 140, 150, 200 and 302.

(2) In the Changqing Branch School to Gansu United University in Sept. 1999, twin prime numbers had been calculated up to the digit 422, 543, 606 and 726.

(3) In the calculation center to Changqing Geophysical Prospecting Company in May 2000, twin prime numbers had been calculated up to the digit 750, 801 (three couples) 1002 (five couples).

In the calculation center to Changqing Geophysical Prospecting Company in June 23, 2000, twin prime numbers had been calculated up to the digit 2003 (two pairs with their value attached below).

During writing the book, the leaders, Sun Yuchen, Feng Shangcun and Cao Shiyi of Changqing Petroleum Prospecting Bureau had given care and favor to it. And during the book was shaping up, the leaders Shi Zhongqian, Yu Liancheng and Zhang Wenjin of the Changqing Branch School to Gansu United University had given great support to it, especially to mention that the leader Shi Zhongqian had given me much help and support during my writing the book. During the calculation of twin prime numbers, Zeng Chenbing and Wang Ruofeng from Chengdu Science

Academy had helped and instructed me with enthusiasm. Great thanks also go to Song Zenghao from China Aeronautics Computing Technique Research Institute, Li Dezhi from Shaanxi Science and Technology University, Yan Kun from Xi'an Modern Non-linearity Science Application Institute and Huang Aixiang from Xi'an jiaotong University. Especially to mention is that, during the calculation of ultra-great twin prime numbers, Xiang Fa and Qian Junsheng from the calculation center to Changqing Geophysical Prospecting Company, Cao Xianghua from Drilling Company had given me great support and cooperated with me with passion. Xiang Fa had done a lot of work for calibrating the material and looking for twin prime numbers. During writing the book, more than 30 experts and colleagues had instructed it. Leaders and editors of Northwestern Polytechnical University Press have done a lot of job in the publication of this book. Thank all the experts and the editors for their help.

If there is anything not properly, your comment and suggestions are welcome.

Yang Maoxiang
May 2003

引　言

数论中一些驰名中外的难题，200 多年来，常胜不衰，具有无穷的魅力，吸引着国内外一流的数学家和数学爱好者，这些难题一直是很多人关注的焦点。

几个世纪过去了，数以千百计的科学家，对数论中的难题进行攻读，耗尽了毕生的精力乃至生命。其中：(1)黎曼猜想，(2)哥德巴赫猜想，(3) 孪生素数猜想，(4) 任意大于 2 的偶数是否可表为两个素数之差，就是数论中很多难题中的几个。

数学家对待这些难题，只能作出一种选择，要么证明它，要么推翻它，二者必择其一。

数学的本质，就是发现新概念，建立新模型，证明新定理。

2000 年作者由根系理论，用了 42 台计算机并行计算，在找到 726 位孪生素数的基础上，把孪生素数计算到 750 位，801 位(三对)，1002 位(五对)，2003 位(二对)。

著　者

Foreword

Some problems about *Number Theory* setting the world on fire has been lasting with their fascination for more than 200 years, which have attracted first-rate mathematicians home and abroad and mathematics fans. The problems have been the focuses of many people concerned.

Quite a few centuries have passed by and thousands of scientists have been devoting themselves to the problems in number theory with all of their energy and even lives used up.

Of the problems in *Number Theory* are (1) Rieman Hypothesis (2) Goldbach Hypothesis (3) Hypothesis of Twin Prime Number (4) May any of even numbers greater than 2 be the difference from two prime numbers?

For the problems, mathematicians can not but make one choice, that is, to prove it or to deny it. Double-talking about it will not do. The essence of mathematics is how to discover new concept with new models set up and new theorem proved.

In 2000, with radical system theory used, the 42 computers had calculated twin prime numbers up to the digit 750, 801(three pairs), 1002 (five pairs) and 2003 (two pairs), on the basis of having found the twin prime numbers of 726 digit.

Author

目　录
Contents