The Discovery of Twin Inaccurate Numbers

Zhi Li and Hua Li
( lizhi100678@sina.com, lihua2057@gmail.com)

Abstract:
Inaccurate numbers are characterized by the irrational square root form, which is an infinite non-repeating decimal, and the last few digits of the numerical calculation result are inaccurate. This paper finds a special kind of inaccurate numbers --- the twin inaccurate numbers, which is characterized by the fact that the sum of the two numbers is exactly equal to a rational number or a single-layer radical irrational number and the difference between the two numbers can be exactly equal to a single-layer radical irrational number. It is named twin inaccurate numbers. It is characterized in that the radicals of the two layers are all squared; the two numbers under the radicals of the second layer are dual irrational numbers.

Key words:
twin number, inaccurate number, dual irrational number

Inaccurate numbers are usually in the form of multi-layer radicals [1], which are characterized by the square root form of irrational numbers and are infinite non-recurring decimals, and the numerical calculation results are inaccurate in the last few digits. The radical form number that cannot be completely square is not a rational number. If the irrational parts of two numbers have the same sign, the sum of the numbers in this form is a rational number or the difference is a single-layer radical irrational number, which has not been reported. This paper finds a new class of inaccurate numbers, which is characterized by the fact that the sum of two such numbers is equal to a rational number or a single-layer radical irrational number, and the difference between two such numbers is equal to a single-layer radical irrational number, which is recommended to be named twin inaccurate numbers. Some examples are as follows.
1. Examples

(1) \[ \sqrt{\frac{3}{2}} - \sqrt{2} + \sqrt{\frac{3}{2} + \sqrt{2}} = 2 \]

(2) \[ \sqrt{\frac{15}{4} + \frac{3}{2} \cdot \sqrt{6}} + \sqrt{\frac{15}{4} - \frac{3}{2} \cdot \sqrt{6}} = 3 \]

(3) \[ \sqrt{\frac{29}{4} + 2 \cdot \sqrt{13}} + \sqrt{\frac{29}{4} - 2 \cdot \sqrt{13}} = 4 \]

(4) \[ \sqrt{12 - \frac{5}{2} \cdot \sqrt{23}} + \sqrt{12 + \frac{5}{2} \cdot \sqrt{23}} = 5 \]

(5) \[ \sqrt{\frac{69}{4} + 3 \cdot \sqrt{33}} + \sqrt{\frac{69}{4} - 3 \cdot \sqrt{33}} = 6 \]

(6) \[ \sqrt{\frac{95}{4} + \frac{7}{2} \cdot \sqrt{46}} + \sqrt{\frac{95}{4} - \frac{7}{2} \cdot \sqrt{46}} = 7 \]

(7) \[ \sqrt{29 + 8 \cdot \sqrt{13}} + \sqrt{29 - 8 \cdot \sqrt{13}} = 8 \]

(8) \[ \sqrt{\frac{159}{4} + \frac{9}{2} \cdot \sqrt{78}} + \sqrt{\frac{159}{4} - \frac{9}{2} \cdot \sqrt{78}} = 9 \]

(9) \[ \sqrt{\frac{197}{4} + 5 \cdot \sqrt{97}} + \sqrt{\frac{197}{4} - 5 \cdot \sqrt{97}} = 10 \]
\[
\sqrt{\frac{7}{4} + \sqrt{3}} - \sqrt{\frac{7}{4} - \sqrt{3}} = \sqrt{3}
\]

\[
\sqrt{\frac{11}{4} + \frac{1}{2}\sqrt{30}} - \sqrt{\frac{11}{4} - \frac{1}{2}\sqrt{30}} = \sqrt{5}
\]

\[
\sqrt{\frac{15}{4} + \sqrt{14}} - \sqrt{\frac{15}{4} - \sqrt{14}} = \sqrt{7}
\]

\[
\sqrt{\frac{23}{4} + \sqrt{33}} - \sqrt{\frac{23}{4} - \sqrt{33}} = \sqrt{11}
\]

\[
\sqrt{\frac{27}{4} + \frac{1}{2}\sqrt{182}} - \sqrt{\frac{27}{4} - \frac{1}{2}\sqrt{182}} = \sqrt{13}
\]

\[
\sqrt{\frac{5}{4} + \frac{1}{2}\sqrt{6}} + \sqrt{\frac{5}{4} - \frac{1}{2}\sqrt{6}} = \sqrt{5}
\]

\[
\sqrt{\frac{11}{4} + \frac{1}{2}\sqrt{30}} + \sqrt{\frac{11}{4} - \frac{1}{2}\sqrt{30}} = \sqrt{6}
\]

\[
\sqrt{\frac{27}{4} + \frac{1}{2}\sqrt{182}} + \sqrt{\frac{27}{4} - \frac{1}{2}\sqrt{182}} = \sqrt{14}
\]
2. Conclusion

It is suggested that this type of numbers be named as twin inaccurate numbers. The characteristics of this type of numbers are:

(1) The two layers radical roots are all square roots, and there is no high-order root form;
(2) The two numbers under the square root of the second layer are dual single-layer irrational numbers;
(3) The sum of two twin inaccurate numbers is exactly equal to a rational number or a single-layer radical irrational number;
(4) The difference between two twin inaccurate numbers can be exactly equal to the single-layer radical irrational number.

3. Inferences

This leads to the twin inaccurate number theorems:

Theorem 1. All rational numbers can be expressed as the sum of a pair of twin inaccurate numbers.
Theorem 2. A single-layer radical irrational number can be expressed as the sum or difference of a pair of twin inaccurate numbers.
Theorem 3. The difference of a pair of twin inaccurate numbers can be expressed as the sum or difference of another pair of twin inaccurate numbers.
4. Reference

1. Zhi Li and Hua Li. Uncertainty in Multi-layer Radical Calculations and Inaccurate Numbers. https://vixra.org/abs/2201.0055