The Logic of Linear Convergence: Remote Chute Pairs

Sudoku Analytical Research

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1 Introduction: The "Tunnel" Effect

While standard Sudoku strategies often focus on single houses (rows, columns, or boxes) or specific chains of candidates, **Remote Chute Pairs** (often called **Chute Clams** or **Parallel Pair Analysis**) leverage the structural geometry of the grid itself. The technique is a powerful intermediate-to-advanced strategy that exploits the alignment of "Chutes" (sets of three parallel rows or columns) to bypass standard visibility rules.

Fundamentally, a Remote Chute Pair pattern identifies a contradiction caused by two specific candidates in two specific cells that, while physically distant, are logically connected through the "tunnel" of a Chute.

2 Anatomy of the Grid: Defining Chutes

To understand this strategy, one must first visualize the grid as a collection of "Chutes" rather than just rows and columns.

2.1 The Concept of a Chute

A standard 9×9 Sudoku grid is composed of 9 rows and 9 columns. However, these are grouped into 3 **Horizontal Chutes** (bands) and 3 **Vertical Chutes** (stacks).

- **Horizontal Chute (Band):** A set of three rows that encompass three entire 3×3 boxes (e.g., Rows 1-3).
- **Vertical Chute (Stack):** A set of three columns that encompass three entire 3×3 boxes (e.g., Columns 1-3).

3 The Logic of Remote Chute Pairs

The Remote Chute Pair strategy is essentially a **Locked Candidates** logic applied across the length of a Chute to form a virtual Naked Pair.

3.1 The Pattern Requirements

A valid Remote Chute Pair requires a very specific setup involving two cells (the **Base Pair**) and a specific alignment.

1. **The Base Pair:** Two cells, C_1 and C_2, with identical candidates {X, Y}.
2. **Same Chute:** They must reside in the same Chute.
3. **Remote:** They share NO common house (different box, different row, different column).

3.2 The "Simple" Remote Pair (Graph Theory)

Often, "Remote Pairs" refers to a chain of bivalue cells {X, Y} of even length.

$$C_1\{1,2\} \rightarrow C_2\{1,2\} \rightarrow C_3\{1,2\} \rightarrow C_4\{1,2\}$$

- If the chain has an **Even** length (4, 6, 8...), the start and end cells effectively have opposite values.
- **Conclusion:** One of C_1 or C_4 MUST be a 1, and the other MUST be a 2.
- **Elimination:** Any cell that sees **both** C_1 and C_4 cannot contain 1 or 2.

4 Visualizing the Elimination

4.1 The Kill Zone

Let's visualize a standard Remote Pair Chain of length 4.

In this diagram, if Cell A (r1c1) and Cell D (r3c9) are the ends of an even chain, then any cell seeing both (like r1c9) can have 1 and 2 eliminated.

5 Summary Table

	Col 1	...	**Col 5**	**Col 9**
Row 1	**{1,2} A**	...	**{1,2} B**	**Target X**
...	...	...	...	...
Row 3	...	...	**{1,2} C**	**{1,2} D**

Table 1: Diagram 1: Remote Pair Elimination

Component	**Candidates**	**Requirement**
Nodes	{A, B}	All cells must have identical bivalue candidates.
Links	Strong	Each step must share a house.
Length	Even	Chain must have an even number of cells.
Elimination	{A, B}	Remove A and B from cells seeing both Ends.

Table 2: Remote Pair Rule Summary