

How Much Cylinder Skew Is Needed For A 7200-rpm Disk With A Track-to-track Seek Time Of 1 Msec? The Disk

How Much Cylinder Skew Is Needed For A 7200-rpm Disk With A Track-to-track Seek Time Of 1 Msec? The Disk

Understanding the concept of cylinder skew is vital when designing or optimizing disk storage systems, especially for high-speed hard disks like those spinning at 7200 rpm. Properly calculating the necessary skew ensures efficient data access, minimizes rotational delays, and improves overall system performance. In this article, we explore how to determine the appropriate cylinder skew for a 7200 rpm disk with a track-to-track seek time of 1 millisecond, providing insights into disk geometry, seek timing, and design considerations.

What Is Cylinder Skew and Why Is It Important?

Definition of Cylinder Skew

Cylinder skew refers to the intentional offset in the starting position of data sectors or tracks on successive cylinders of a disk. It is used to account for the disk's rotational latency and seek times, allowing the read/write head to move smoothly from one cylinder to the next without waiting excessively for the disk to rotate to the correct position.

Importance of Cylinder Skew in Disk Performance

By applying the correct amount of skew:

- The disk head can move to the next cylinder while the platter is spinning, reducing idle time.
- The overall data transfer rate improves.
- Seek operations are optimized, decreasing latency.

Properly calculated skew minimizes the total access time, making data retrieval faster and more efficient, especially in systems with high transfer demands.

Understanding Disk Specifications and Their Impact on Skew Calculation

Before calculating the skew, it's essential to understand the key parameters involved:

1. Disk Rotation Speed (RPM)

- For our case: 7200 RPM.
- Rotation speed determines the rotational latency and the time it takes for a sector to come under the read/write head.

2. Track-to-Track Seek Time

- Given as 1 millisecond.
- Represents the time required for the head to move between adjacent tracks (or cylinders in this context).

3. Number of Cylinders and Tracks

- Although not explicitly given, typical disk geometries can be assumed or derived based on common specifications.

4. Sector Size and Data Layout

- These influence how data is organized and how skewing affects access times.

Calculating the Disk Rotation Period

The disk rotation period is the time it takes for the disk to complete one full rotation, which is crucial in understanding the rotational latency and how skew should be applied.

Formula for Rotation Period

$$T_{\text{rotation}} = \frac{60}{\text{RPM}} \times 1000 \text{ milliseconds}$$

Applying the given RPM:

$$T_{\text{rotation}} = \frac{60}{7200} \times 1000 = \frac{1}{120} \times 1000 \approx 8.33 \text{ milliseconds}$$

Result:

The disk completes one rotation approximately every 8.33 ms.

Understanding Seek Time Components

The total access time for a disk includes several components:

- Seek Time: The time to move the read/write head to the correct cylinder.
- Rotational Latency: The delay waiting for the desired sector to rotate under the head.
- Transfer Time: The time to actually read or write data once the head is in position.

Given:

- Track-to-track seek time = 1 ms.
- No specific transfer time provided, but it generally depends on data size and disk bandwidth.

Determining the Skew to Optimize Performance

What Is the Goal?

The main goal of skewing is to ensure that when the head moves from one cylinder to the next, the disk has already rotated to the position where the desired sector is accessible, minimizing rotational delay.

Key Insight

- When moving from one cylinder to the next, the head takes 1 ms for the seek.
- During this seek, the disk continues to rotate.
- The skew should compensate for the rotation delay so that the next read starts immediately upon head positioning.

Calculating the Appropriate Cylinder Skew

Step 1: Determine the Rotation Time for One Sector

Since the disk completes a full rotation every 8.33 ms:

- The time for a single sector to pass under the head depends on the number of sectors per track.
- For simplicity, assume the disk has 100 sectors per track (a common approximation).

Then:

$$T_{\text{sector}} = \frac{T_{\text{rotation}}}{\text{sectors per track}} = \frac{8.33 \text{ ms}}{100} \approx 0.0833 \text{ ms}$$

Note: The actual number of sectors varies, but this approximation helps illustrate the concept.

Step 2: Calculate the Skew in Terms of Sectors or Time

- Since the seek time is 1 ms, and the rotation time per sector is approximately 0.0833 ms, the head will be moving during the disk rotation.

To ensure the next sector is ready when the head arrives:

$$\text{Skew} \approx \text{Seek Time} - \text{Average Rotational Latency}$$

The average rotational latency is roughly half the rotation time:

$\text{Average Latency} \approx \frac{T_{\text{rotation}}}{2} \approx 4.17 \text{ ms}$

]

However, since we want to optimize for the worst case (or for the next track), the skew should compensate for the rotational delay during the seek.

Therefore:

[

$\text{Cylinder Skew} \approx \text{Seek Time} - \text{Average Rotational Latency}$

]

But because the seek time (1 ms) is less than the average rotational latency (4.17 ms), the skew should be set such that:

[

$\text{Skew} \approx \text{Seek Time} + \text{Additional Offset}$

]

In practical terms, disk engineers often set the skew to approximately the sum of the seek time and the average rotational latency, or slightly less to prevent head waiting.

Step 3: Express Skew in Terms of Sectors or Time

Given the above:

- To minimize delay, skew should be close to the rotational delay experienced during the seek.
- For a 7200 rpm disk, the maximum rotational delay is approximately 8.33 ms.
- Since the seek time is only 1 ms, and the average rotational delay is around 4.17 ms, the skew

should be set approximately to:

$$\text{Skew} \approx 1 \text{ ms} + 4.17 \text{ ms} \approx 5.17 \text{ ms}$$

- Converting this to sectors:

$$\text{Sectors to Skew} = \frac{5.17 \text{ ms}}{0.0833 \text{ ms per sector}} \approx 62 \text{ sectors}$$

Result:

Set the cylinder skew to approximately 62 sectors ahead to ensure the sectors are aligned for sequential track access within the seek time.

Practical Recommendations and Considerations

1. Adjust for Disk Geometry

- The exact number of sectors per track varies among disks.
- Use the specific disk's sector count to refine the skew calculation.

2. Account for Variability in Seek Times

- Seek times can fluctuate based on disk condition and workload.
- Adding a safety margin (e.g., skew of 60-70 sectors) can improve performance consistency.

3. Use Disk Utilities and Testing

- Many disk manufacturers or system administrators use benchmarking tools to empirically determine optimal skew values.
- Regular testing helps to refine skew settings over the disk's lifespan.

4. Consider Data Layout and Access Patterns

- Sequential access patterns benefit most from proper skew settings.
- Random access may require different skew configurations.

Conclusion

Determining the correct cylinder skew for a 7200 rpm disk with a 1 millisecond track-to-track seek time involves understanding the interplay between rotational latency, seek time, and disk geometry. Based on the calculations, setting the skew to approximately 62 sectors ahead of the current position aligns the disk's rotation with seek operations, minimizing delays and optimizing throughput.

Properly configured cylinder skew enhances disk performance by reducing idle time and ensuring data sectors are positioned optimally for sequential access. Always tailor skew settings to the specific disk's sector count, workload, and access patterns, leveraging empirical testing to achieve the best results.

In summary:

- Calculate the disk's rotation period (≈ 8.33 ms).
- Determine the average rotational latency (≈ 4.17 ms).
- Convert the combined seek and latency delay into sectors (≈ 62 sectors).
- Set the cylinder skew accordingly to ensure seamless data access.

By applying these principles, system designers and administrators can improve disk efficiency, reduce latency, and ensure smoother data transfer operations in high-speed storage environments.

Frequently Asked Questions

What is the relationship between cylinder skew and seek time in a 7200-rpm disk?

Cylinder skew is used to offset the starting position of adjacent tracks to enable sequential reads without waiting for the disk to rotate fully, thus reducing seek time in high-speed disks such as those spinning at 7200 rpm.

How do you calculate the required cylinder skew for a disk with a 1 ms track-to-track seek time?

The cylinder skew angle can be approximated by considering the rotation time of the disk and the seek time. For a 7200 rpm disk, the rotation period is about 8.33 ms. To achieve a 1 ms seek time, the skew should be set so that the next track is ready after the arm moves, typically around $1/\text{number of tracks per rotation}$, adjusted for the rotation time.

Why is cylinder skew important for optimizing disk performance at 7200 rpm?

Cylinder skew reduces the wait time caused by disk rotation, allowing sequential reads across multiple tracks with minimal delays, which is especially beneficial at 7200 rpm where rotation speed is high.

How does the rotational latency of a 7200-rpm disk influence the calculation of cylinder skew?

Since a 7200 rpm disk has a rotation period of approximately 8.33 ms, the cylinder skew should be set to align the next track's data with the read/write head's position after a seek, minimizing waiting time caused by rotational latency.

Is the track-to-track seek time of 1 ms typical for a 7200 rpm disk, and how does it relate to cylinder skew?

A 1 ms track-to-track seek time is feasible for a 7200 rpm disk with optimized mechanics. The cylinder skew should be calculated to match this seek time, ensuring that the disk's rotation aligns with the head movement for efficient sequential access.

What practical steps are involved in determining the exact cylinder skew for a disk with specified seek time and RPM?

Determine the rotation period from RPM, calculate the time it takes for one track to pass under the head, and then set the cylinder skew to offset the starting position of adjacent tracks to match the seek time, often using empirical testing for precision.

How does increasing cylinder skew affect disk throughput at 7200 rpm?

Appropriate increase in cylinder skew can improve throughput by allowing continuous data transfer without waiting for disk rotation, but excessive skew may cause misalignment and reduce efficiency. Finding the optimal skew balances seek time reduction and data alignment.

Additional Resources

How Much Cylinder Skew Is Needed For A 7200-rpm Disk With A Track-to-track Seek Time Of 1 Msec? The Disk

Understanding the optimal amount of cylinder skew in a disk drive is critical for maximizing data transfer efficiency and minimizing latency, especially in high-performance systems. When dealing with a 7200-rpm disk that exhibits a track-to-track seek time of approximately 1 millisecond, knowing how much skew to apply across cylinders can significantly influence read/write performance. This article

provides a comprehensive analysis of the factors involved and offers guidance on calculating the appropriate cylinder skew.

Introduction to Cylinder Skew and Its Importance

Disk drives organize data into tracks and cylinders. A cylinder consists of the same track number on multiple platters, aligned vertically. When multiple read/write heads operate simultaneously, their positioning and synchronization become crucial for efficient data access.

Cylinder skew refers to the deliberate rotation offset applied between adjacent cylinders to compensate for the rotational latency when moving the read/write heads from one track to the next in sequence. Proper skew alignment ensures that after a seek, the subsequent data access can occur with minimal waiting for the disk to rotate into position, effectively reducing overall access time.

Why is cylinder skew important?

- It reduces the rotational latency during sequential reads or writes across cylinders.
- Proper skew minimizes the need for waiting for the disk to spin into the correct position, which improves throughput.
- In systems with high seek rates, optimizing skew can lead to noticeable performance gains.

Fundamental Concepts and Definitions

Before calculating the skew, it's essential to understand some key parameters:

- Disk RPM (Revolutions Per Minute): Number of rotations the disk completes per minute.
- Average rotational latency: Time taken, on average, for the disk to rotate to the desired position, typically half a revolution.

- Track-to-track seek time: The time taken to move the read/write head from one track to an adjacent track.
- Cylinder seek time: The time to move the head across multiple cylinders (includes seek time and rotational latency).
- Skew angle: The angular offset applied between successive cylinders.

Step 1: Calculating the Disk's Rotation Period

The first step involves determining how long it takes for the disk to complete one full revolution, as this directly influences the skew calculation.

Given:

- RPM = 7200

Rotation period (T):

$$T = \frac{60 \text{ seconds}}{\text{RPM}}$$

$$T = \frac{60}{7200} = 0.00833 \text{ seconds} \approx 8.33 \text{ ms}$$

Interpretation:

- The disk completes one revolution every approximately 8.33 milliseconds.

Step 2: Understanding the Track-to-Track Seek Time

Given:

- Track-to-track seek time = 1 ms

This is the time to move the head from one track to the adjacent track, which is relatively fast and indicates a well-optimized drive.

Note:

The track-to-track seek time primarily accounts for the mechanical movement of the actuator. The total seek time across multiple tracks will typically be higher, but for skew calculations, the focus is on adjacent movement.

Step 3: Calculating the Average Rotational Latency

The average rotational latency is the expected time for the disk to rotate to the desired position after a seek completes.

$$T_{\text{Average rotational latency}} = \frac{T}{2}$$

$$T = \frac{8.33 \text{ ms}}{2} \approx 4.17 \text{ ms}$$

This means, on average, after moving the head to a track, the system waits about 4.17 ms for the disk to spin into the correct position.

Step 4: Determining the Skew Angle

The goal of skewing is to offset successive cylinders so that when the head moves to the next cylinder, the desired sector is already aligned or close to alignment with the disk's rotation, minimizing additional rotational delay.

Key idea:

- The skew angle should match the angle the disk rotates during the time it takes to move from one cylinder to the next plus the rotational latency.

Calculating the skew angle (θ):

- The disk rotates through 360 degrees in T milliseconds.
- The time to move between cylinders includes both seek time and the rotational latency.

Since the seek time is 1 ms, and the average rotational latency is approximately 4.17 ms, the total time to position the head and access data is roughly:

$$t_{\text{total}} = 1\text{ ms} + 4.17\text{ ms} \approx 5.17\text{ ms}$$

Skew angle formula:

$$\theta = \frac{t_{\text{total}}}{T} \times 360^\circ$$

$$\theta = \frac{5.17\text{ ms}}{8.33\text{ ms}} \times 360^\circ$$

$$\theta \approx 0.62 \times 360^\circ \approx 223^\circ$$

This result indicates that to optimize sequential access between cylinders, the skew angle should be approximately 223 degrees.

Step 5: Interpreting the Result

A skew angle of approximately 223 degrees suggests that each subsequent cylinder's data should be offset by this angle relative to the previous one. However, in practical implementations, skew angles are often kept within 0-180 degrees because:

- Skew angles greater than 180 degrees would effectively be the same as less than 180 degrees, just

in a different direction.

- Most drives use skew angles in the range of 20-45 degrees for optimal performance.

Why the large skew angle?

Because the total time to move and wait for the disk is significantly influenced by the rotational latency, and with a relatively quick seek time (1 ms) compared to the full rotation period, the skew angle becomes large to compensate for this.

Practical Considerations

In real-world systems:

- Skew angles are typically smaller (around 20-45 degrees) because of physical constraints and the desire to balance seek time and rotational latency.
- Trade-offs exist: Larger skew angles reduce rotational wait for sequential access but may cause inefficiencies in random access patterns.
- Drive firmware or controller settings often incorporate predetermined skew values based on empirical data and drive specifications.

Final Recommendations and Summary

- For a 7200-rpm disk with a track-to-track seek time of 1 ms, the ideal cylinder skew angle to minimize rotational delays during sequential access can be calculated to be approximately 223 degrees, considering the combined seek and rotational latency.
- In practice, due to physical and design constraints, skew angles are often set between 20 to 45 degrees to balance efficiency and feasibility.
- Key steps to determine your specific skew:
 1. Calculate the disk's rotation period.
 2. Determine the total seek and rotational latency.

3. Compute the skew angle using the proportion of total latency to rotation period.
4. Adjust based on system architecture, physical constraints, and empirical testing.

In conclusion, understanding and applying the correct cylinder skew can lead to significant improvements in disk performance, especially in environments with high sequential data access demands. When configuring or designing disk systems, taking these calculations into account ensures optimal utilization of hardware capabilities.

Note: Always consider the specific characteristics of your disk drive and workload patterns. Empirical testing and tuning of skew angles can further enhance performance beyond theoretical calculations.

How Much Cylinder Skew Is Needed For A 7200 Rpm Disk With A Track To Track Seek Time Of 1 Msec The Disk

How Much Cylinder Skew Is Needed For A 7200 Rpm Disk With A Track To Track Seek Time Of 1 Msec The Disk

Related Articles

- [Compare And Contrast Dominant And Recessive Alleles, Homozygous And Heterozygous, Phenotype And Genotype](#)
- [Fill In The Blank With The Correct Imperfect Conjugation Of The Verb In Parentheses. Ella _____ A Asistir](#)
- [Assume A Firm Has A Debt-equity Ratio Of .48. The Firm's Cost Of Equity Is: Directly Related To The Risk](#)

[Back to Home](#)