Computational Methods of Signal Decoding for Recovering Recorded Data

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ActionFront Data Recovery Labs

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Computational Methods of Signal Decoding for Recovering Recorded Data

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April 14, 2004 MSST 2004, WIP Presentation

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Professional Data Recovery

- ***Professional* Data Recovery is the process of obtaining usable data from downed computers and backups and corrupted or deleted file sets.**
  - Very labor intensive, highly technical.
  - Usually performed in a controlled lab environment
  - Each case is unique
  - Logical and Physical methods
- Different from “Disaster Recovery”
  - Usually means retrieving data from backups

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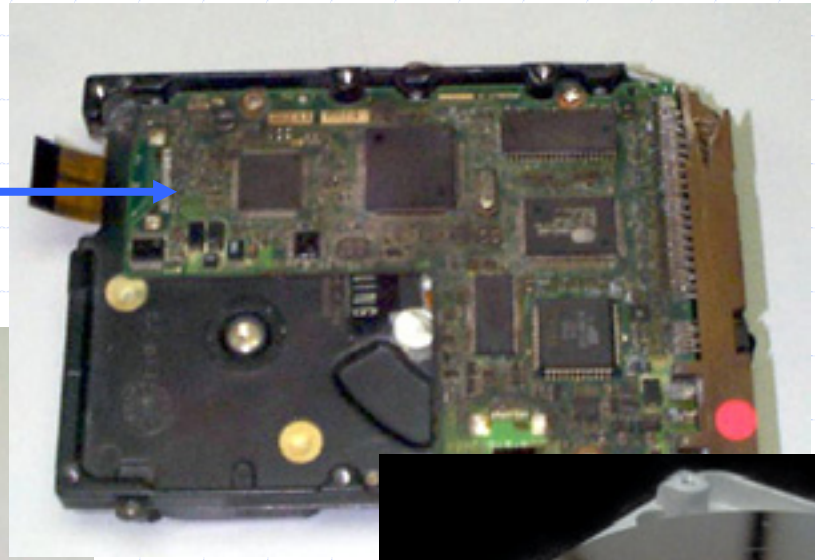
These “Disasters” Need “Data Recovery”

Damaged PCB
(Printed Circuit Board)



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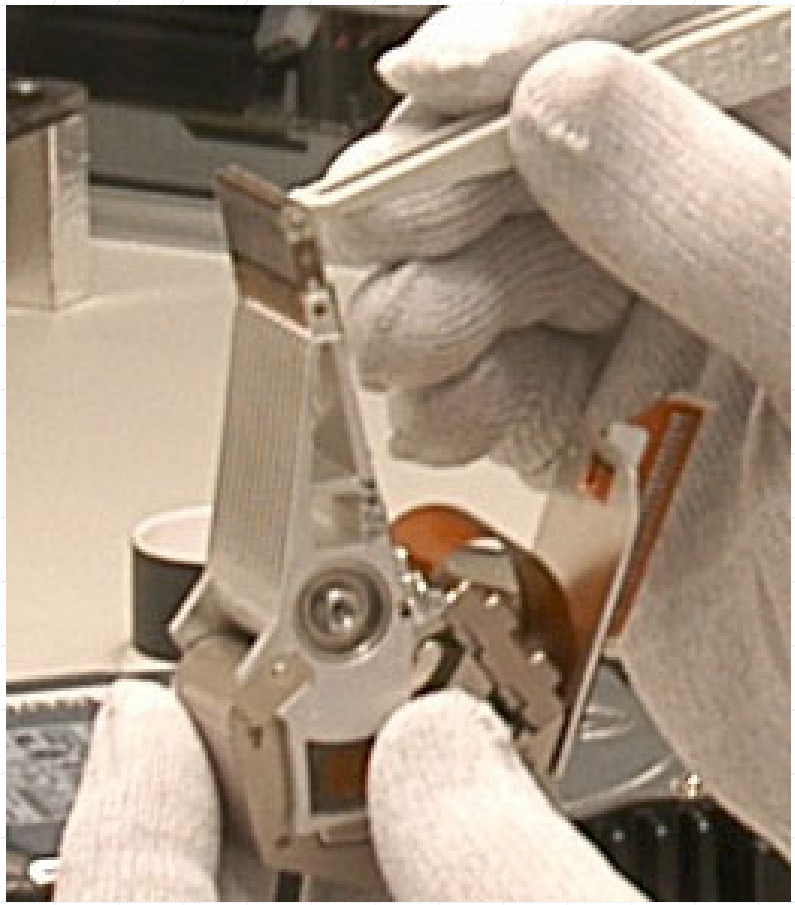
The Current State-of-the-Art Recovery Technique

- Careful part-replacement
- In a controlled environment

- Some failed drives are currently un-recoverable, …
- Why?



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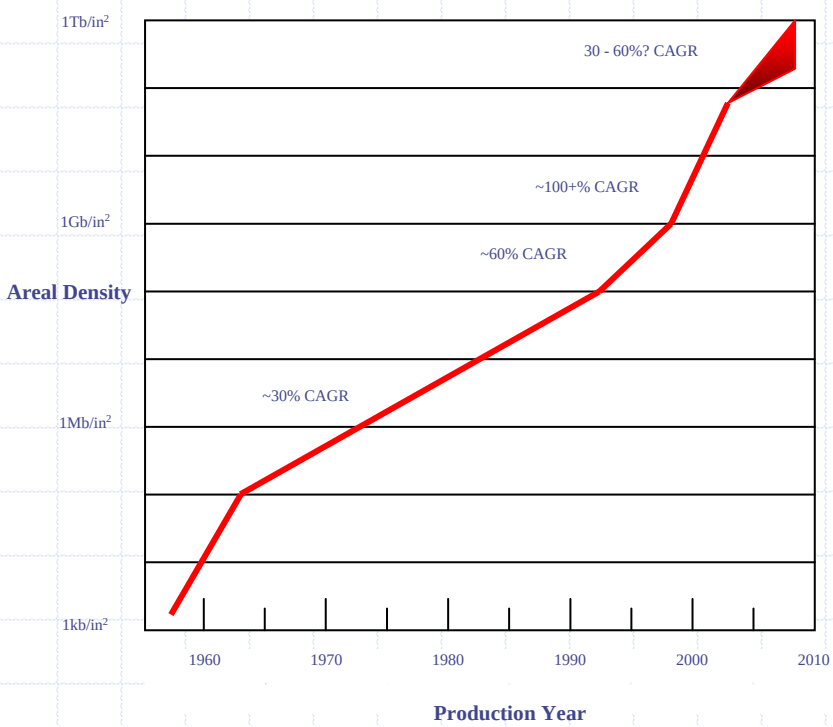
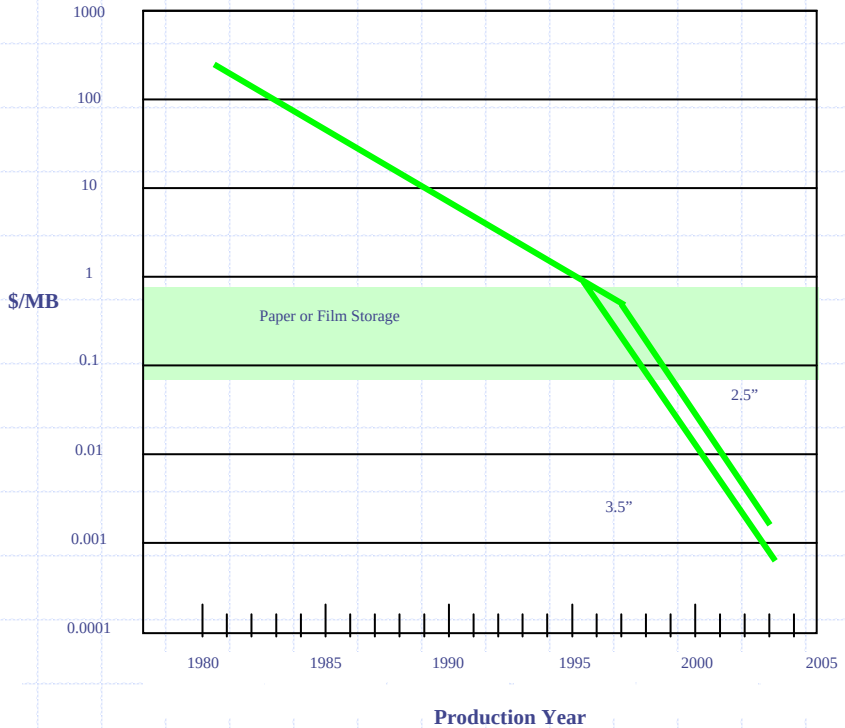
High Capacity
High Technology



Low Cost
High Yields



Hyper-Tuned Hard Disk Drives

Tuned During “Burn-in” in the Manufacturing Process

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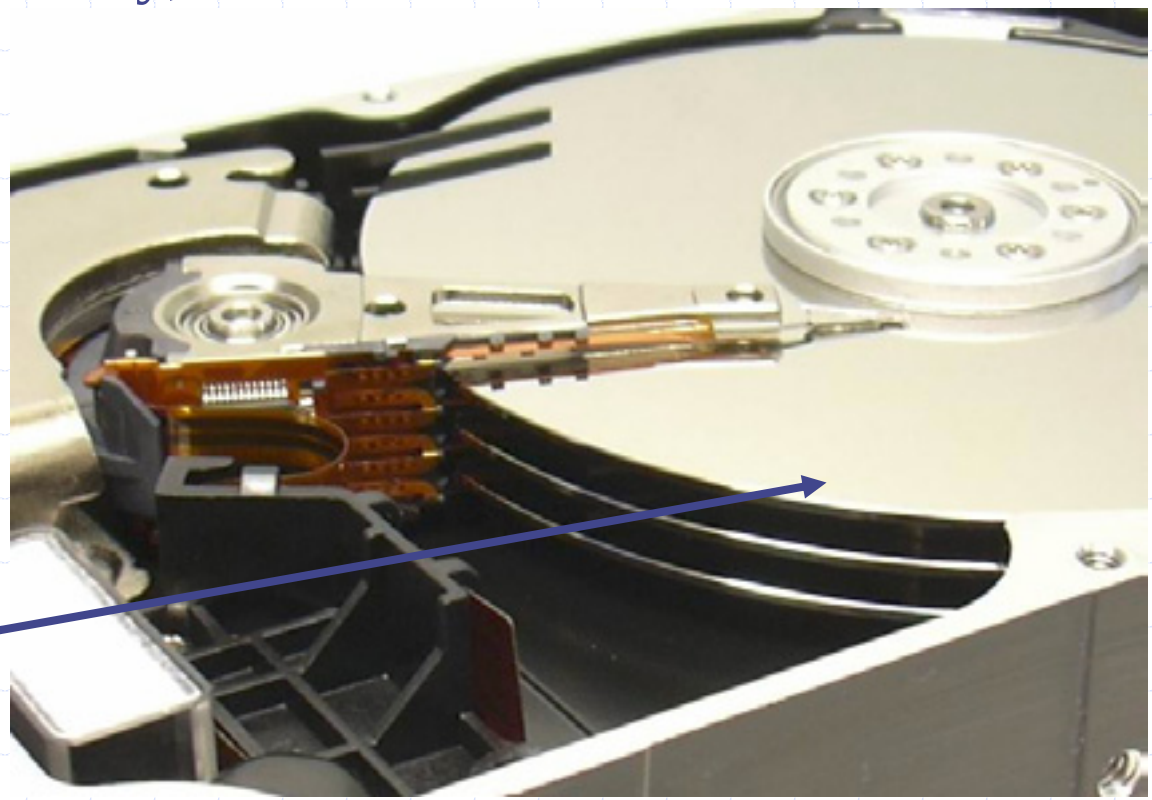
Variable Parameters must be Optimized, Leading to “Hyper-Tuned” Drives

The hyper-tuned parameter settings must be stored in a non-volatile memory, for the life of the drive

Where?

- ROM
- Disk

Typically, Right Here!



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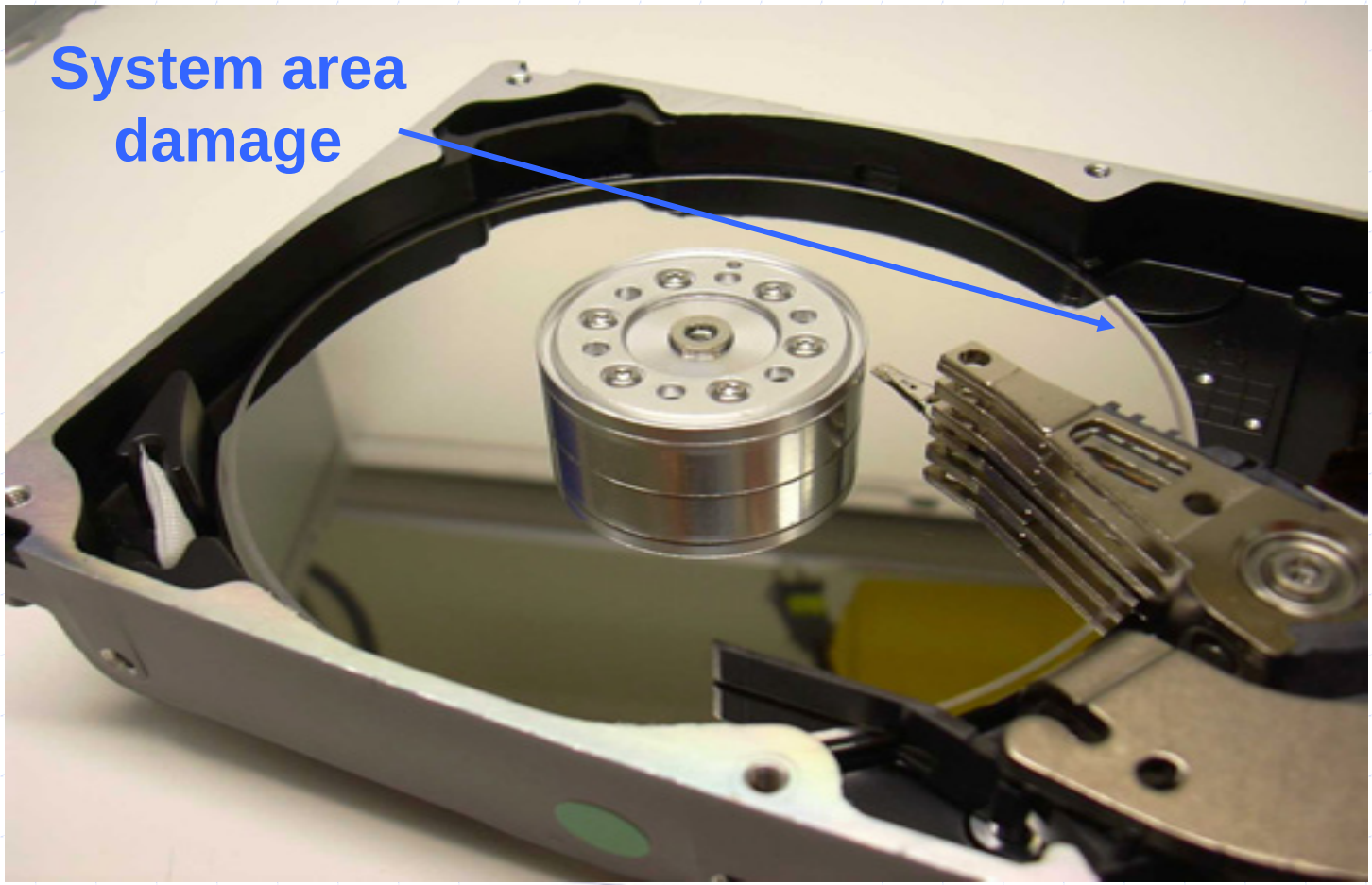
Now What?



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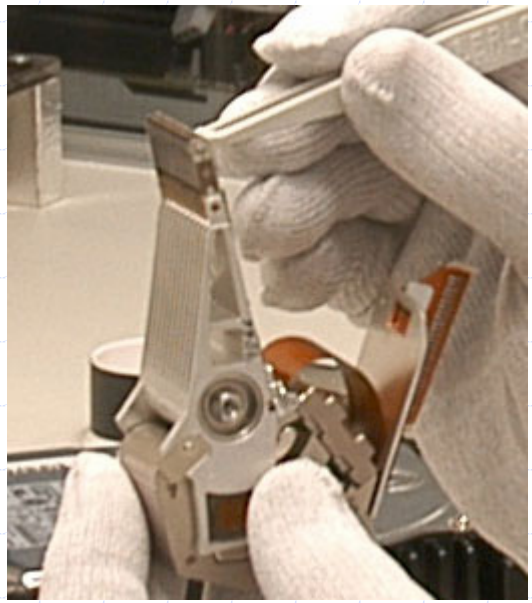
When Hyper-tuning Information is Lost, ...

- The drive might not be able to
  - Seek to a track
  - Locate a sector
  - Identify remapped defective sectors
  - Read data with sufficient raw bit error rate (before ECC correction) to provide data integrity

When Hyper-tuning Information Does Not Match the Components …

- It is almost the same as being lost
- Current state-of-the-art in data recovery is careful part-replacement
- Head transplants can be successful, but if the tuning parameters are wrong for this new head/disk/electronics combination seeking and data integrity can fail



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The Need for Drive-Independent Data Recovery

- Needed Now; plus, ...
- Trend: More hyper-tuned parameters
- Trend: Lower success rates for component repair/replacement method
- Trend: Higher density (smaller bits) leads to more rapid thermal decay of data

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Drive-Independent Data Recovery Requirements

- Economical & timely
- Read data sectors from anywhere on disk surface
- Continually, incrementally improve to work at the lower SNRs of newer drives
- Flexible to accommodate the differences between the signal processing and coding used by each drive manufacturer, each drive model, and even each drive
- Compatible with other methods of acquiring signals from deliberately damaged disks as an aid to worldwide counter-terrorism activities of law enforcement.

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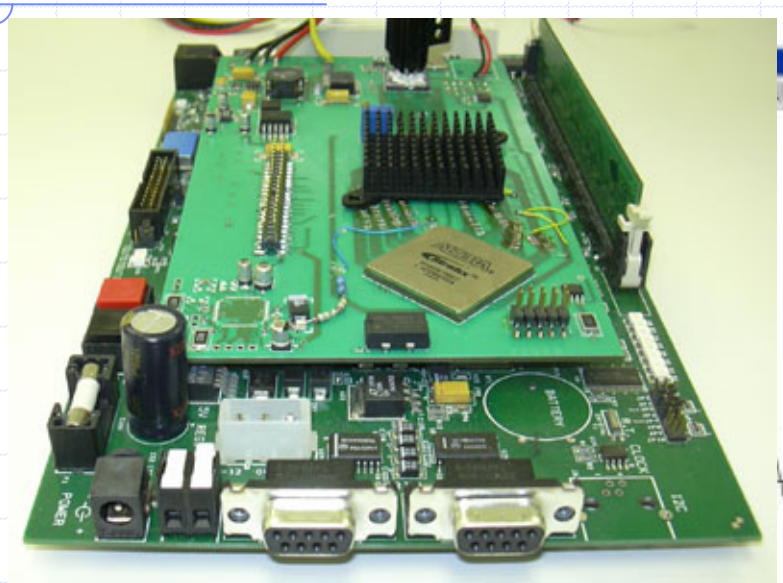
Parameter Determination Through SignalTrace™ Technology

- Servo layout and pattern
- Zone table
- PRML/NPML read channel parameters
- Synchronization
- RLL codes, descrambling, and error correction codes (ECC)

ActionFront Data Recovery Labs' SignalTrace™ Prototype Implementation



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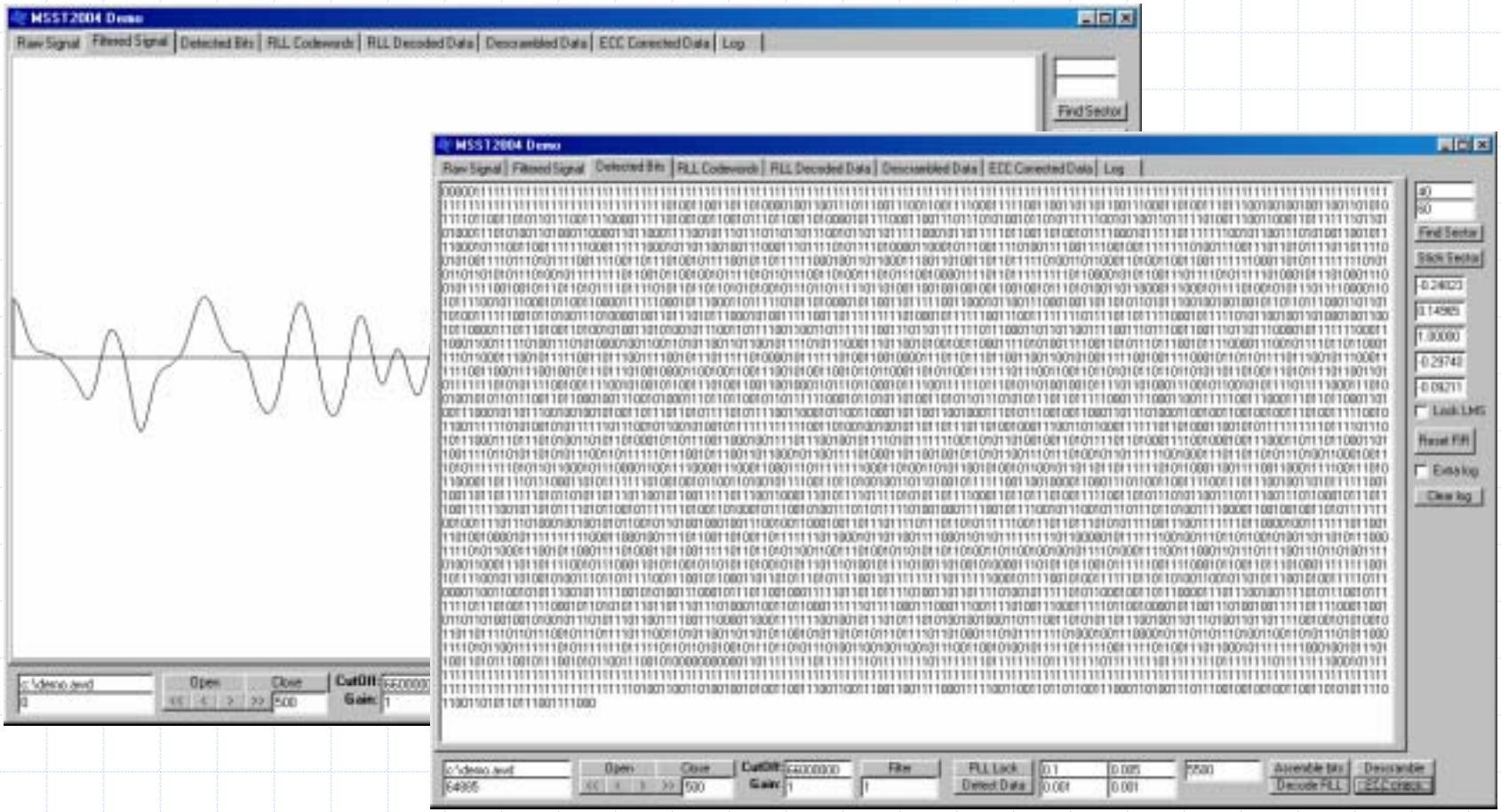
Filter and Detect Data



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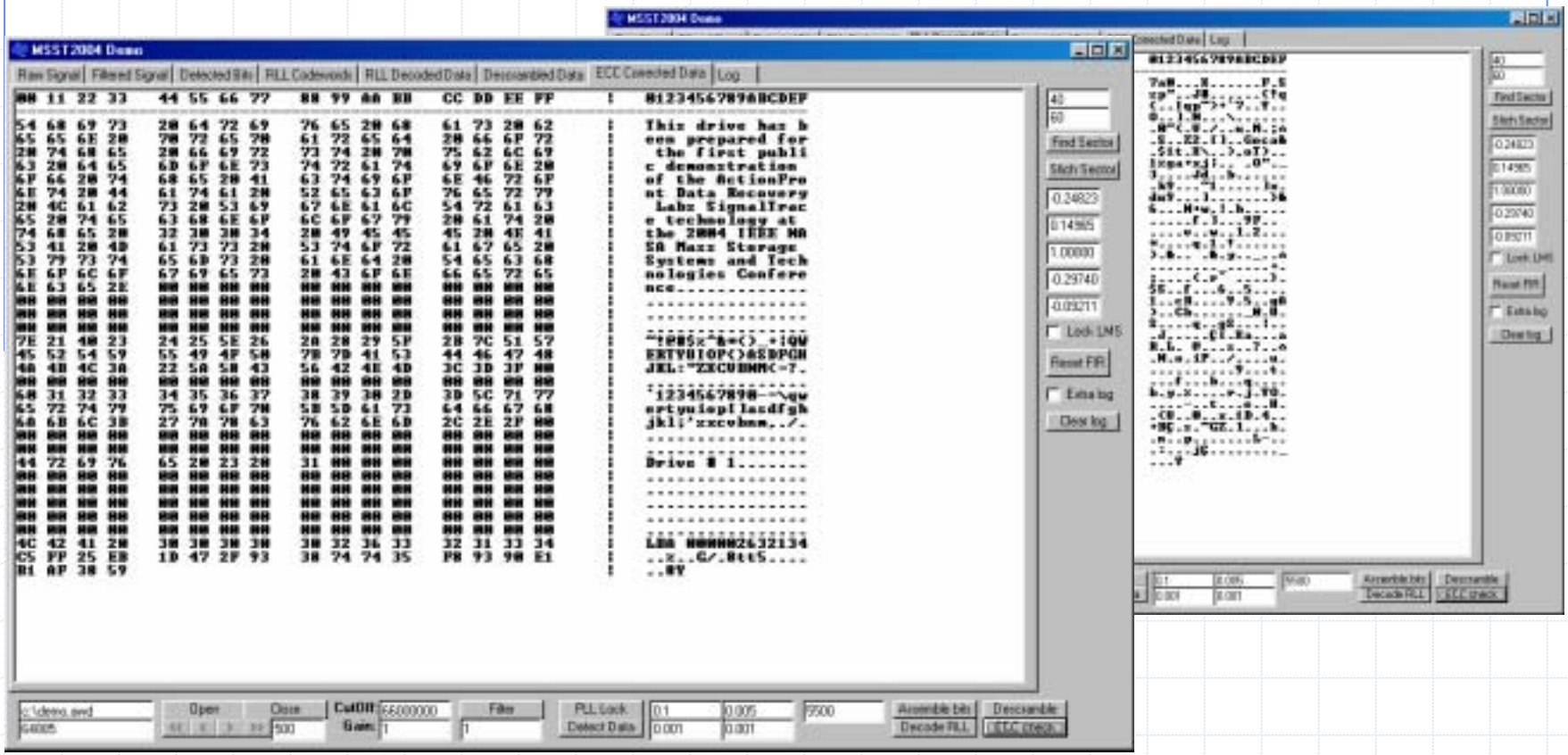
Decode the Recording Code, Descramble the Data, and Make ECC Corrections



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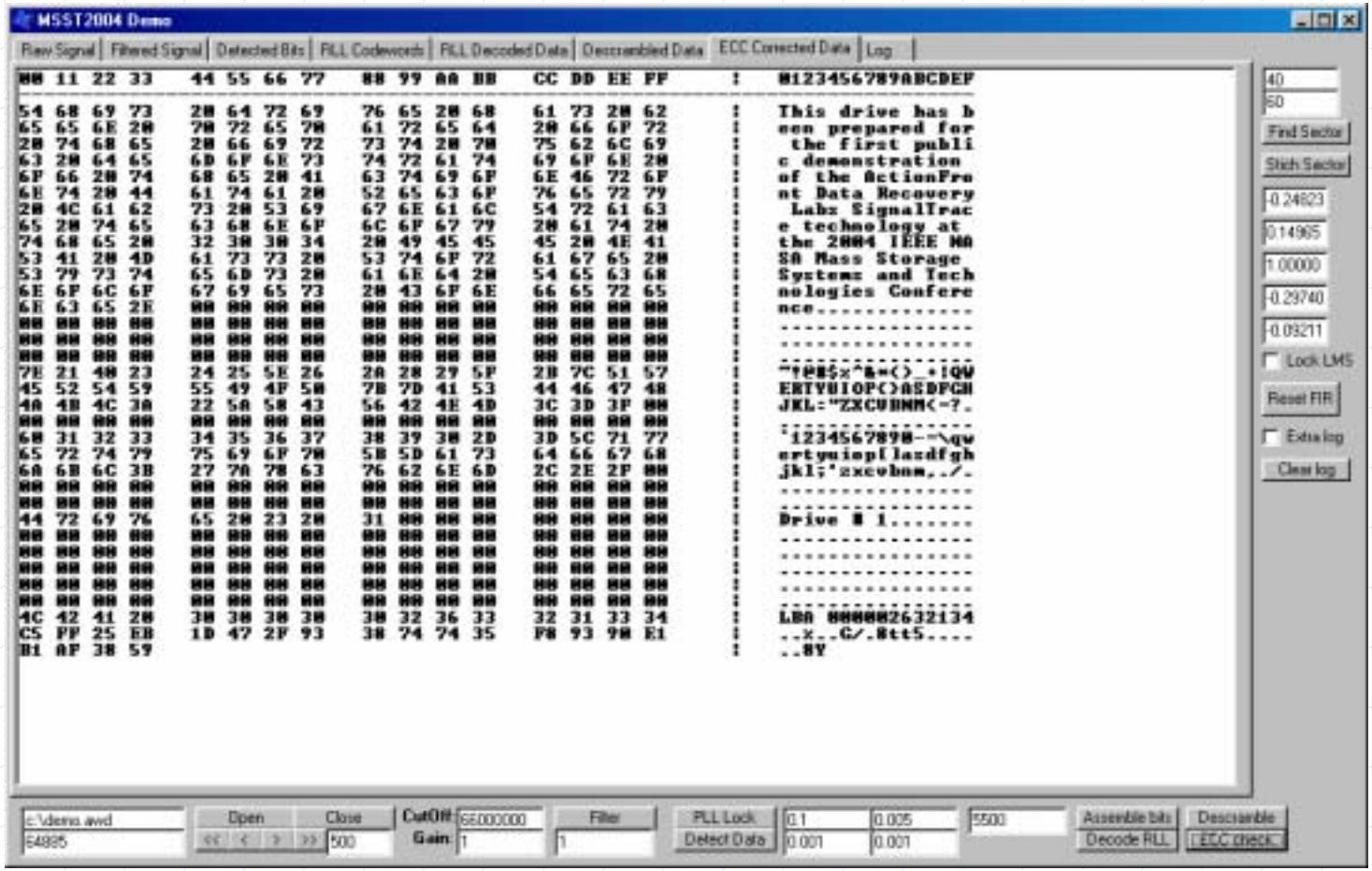
Successful Drive-Independent Recovery Using SignalTrace™



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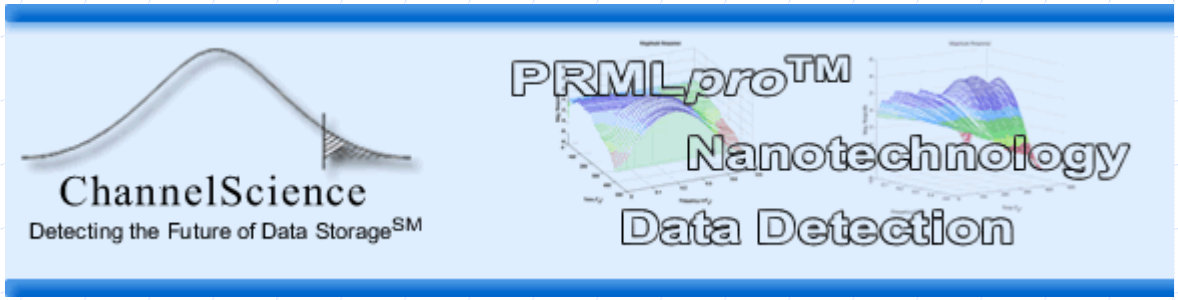
A New White Paper Now Available: *Recovering Unrecoverable Data*

- ChannelScience (www.ChannelScience.com) white paper, commissioned by ActionFront



- Provides a rare overview of data recovery techniques, identifies the need for drive-independent data recovery, and describes the results obtained with the prototype SignalTrace™ system.

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The SignalTrace™ prototype is the only solution known to-date, that can recover data from (previously) un-recoverable media.

We invite you to see a demonstration of SignalTrace™ and preview the white paper at the ActionFront booth.

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Recovering Unrecoverable Data

The Need for Drive-Independent Recovery

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Data Recovery Methodology from Damaged Drives

- Logical recovery from corruption or deletion & formatting errors.
- Physical external recoveries:
  - Swapping firmware
- Physical internal recoveries:
  - Repair/replace components in HDA
  - Most difficult

Some damaged drives are currently un-recoverable.

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Hyper-tuning is a Proprietary Process for Each Manufacturer

- Currently there is no universal way to trigger a re-optimization of parameters in the field
- Even if there were, the parameters must be optimized for the currently written data – not for the data written by transplanted heads
- This includes bpi/tpi information (adaptive formatting) and recording code used

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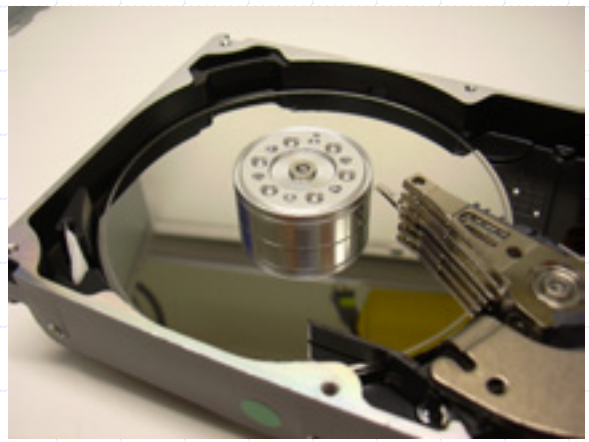
Some Damaged Drives Currently Un-Recoverable.

- Head crash on park zone:
  - Severe damage but not to actual data.
  - Good chance for recovery.
- Head crash affecting track 0 and data zone:
  - Even slight damage in data zone means lower chance for recovery.
  - This area also contains larger firmware programs used by the drive to control itself after spin-up.



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Fixed Parameters Become Variable

Achieving high manufacturing yields, combined with high capacity, requires the head, medium, and electronics – and how they interact – to be precisely matched.

For example,

- Data rate (bpi) varies as a function of radius
- Magnetic spacing *ceases* to vary with radius
- Sector location varies with defect
- Write current
- Read bias current
- PRML/NPML Read Channel Parameters
- Recording code
- Adaptive formatting (bpi/tpi optimization)

… and how these parameters change over time, …

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