Fraunhofer FOKUS
Institut für Offene Kommunikationssysteme

GEFÖRDERT VOM
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für Bildung
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Deep Encode:
Machine Learning for Per-Title Encoding

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Per-Title Encoding – What & Why & How?

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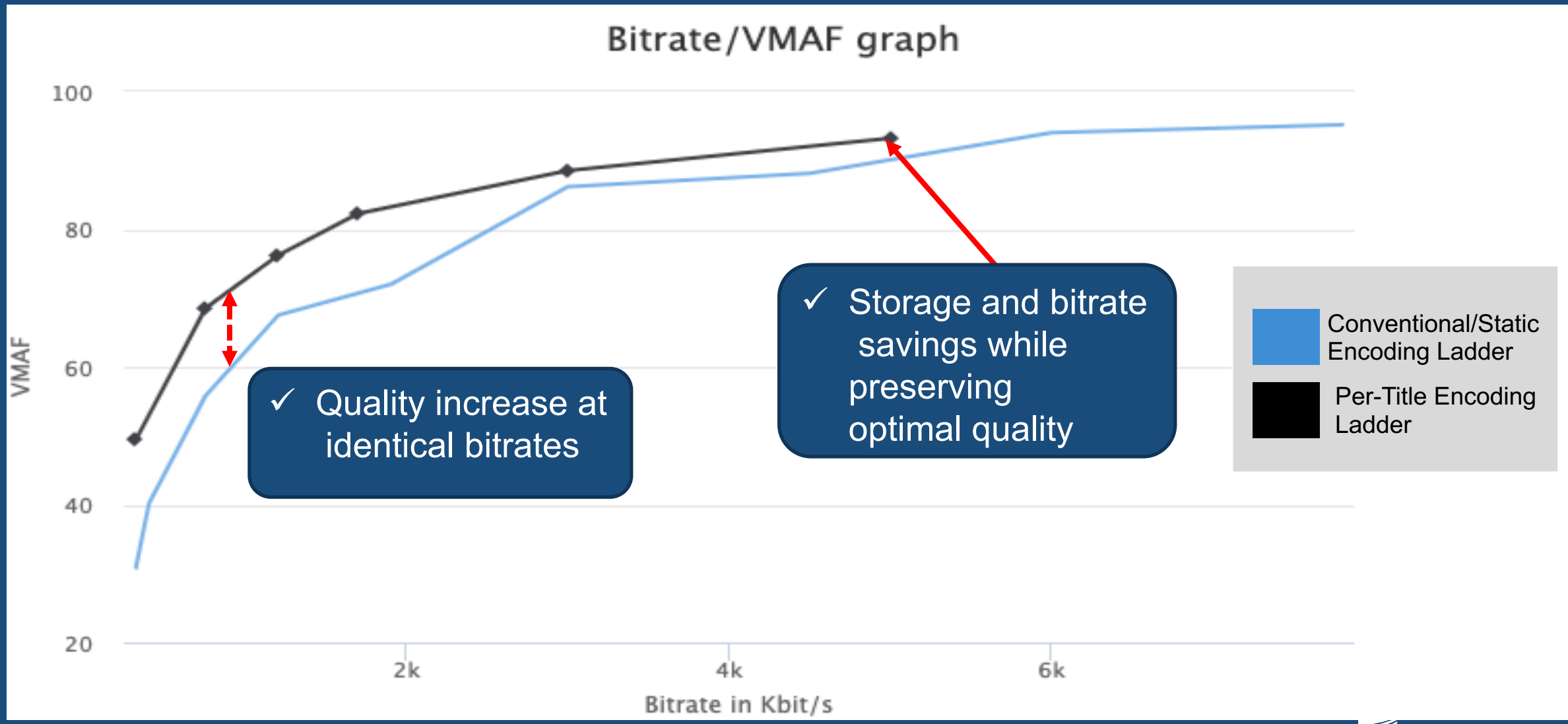
Benefits of Per-Title Encoding



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Benefits of Per-Title Encoding: the Numbers

	Average values			
	Bitrate (kbit/s)	**VMAF**	**PSNR (dB)**	**Storage (MB)**
Conventional	7648.18	94.92	44.37	1397.7
Per-Title	4941.75	93.06	42.41	675.2
Difference Abs	+2706.43	-1.86	-1.96	+722.5 MB
Difference (%)	+36%	-1%	-4%	+52%

* Based on a streaming session with a 100Mbit/s connection in dash.js 3.1.1

How does Per-Title Encoding work?

Test Encodes

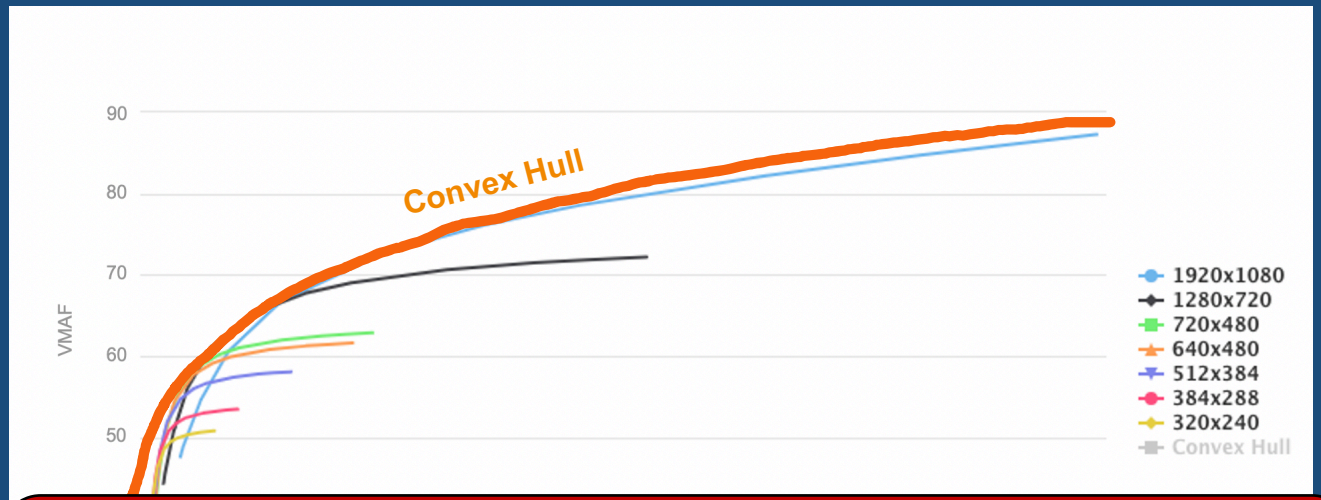
- Perform test encodings with different settings and calculate corresponding VMAF values.

Convex Hull Estimation

- Select bitrate-resolution pairs that are close to the convex hull.

Production encoding

- Perform the production encoding using the optimal encoding ladder.



! A large amount of test encodes is required to derive a sufficient amount of data points.

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Machine Learning for Per-Title Encoding

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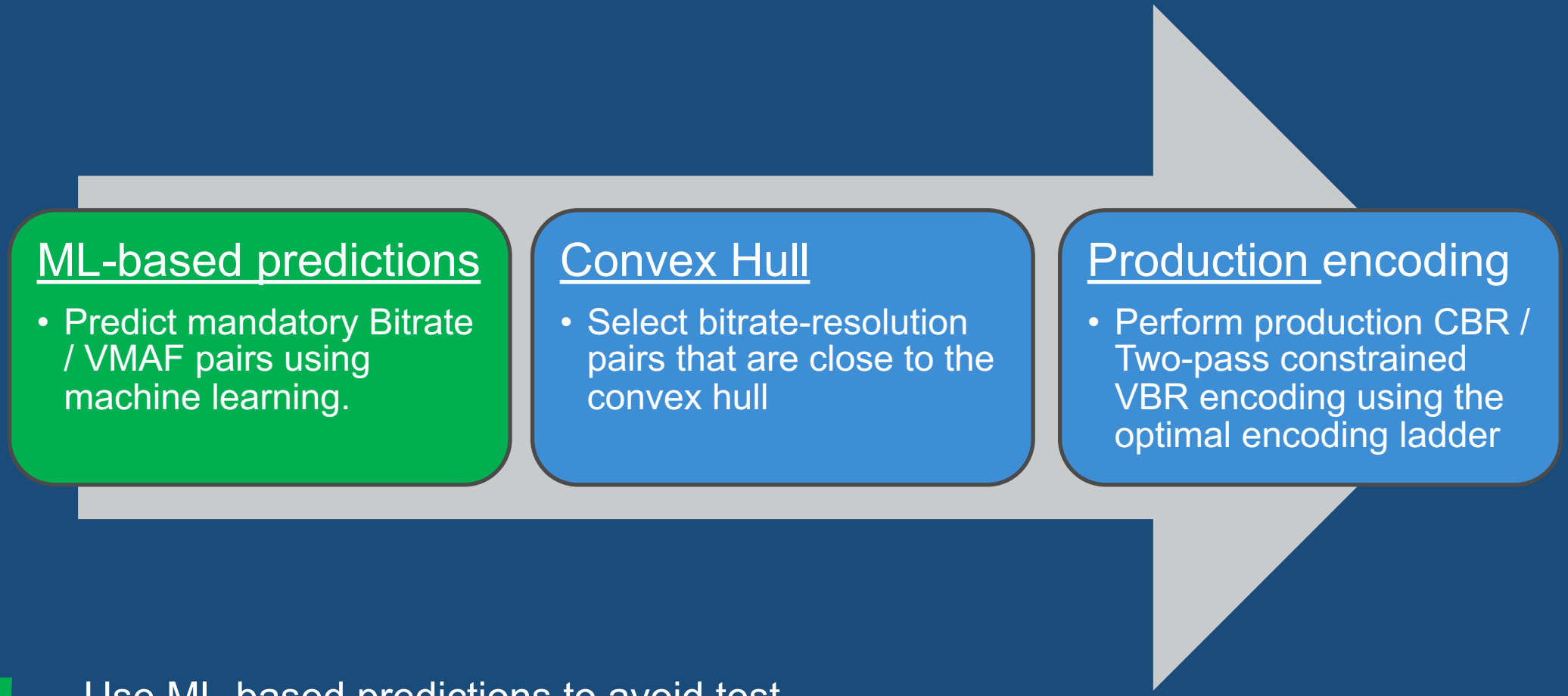
How to avoid the computationally heavy test encodes



! Use ML-based predictions to avoid test encodes and *still* derive a sufficient amount data points.

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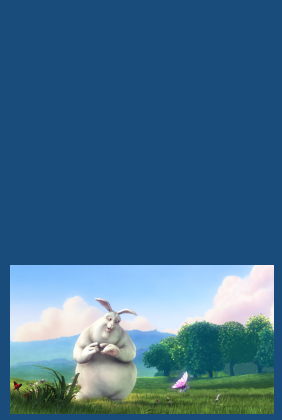
Deep Encode – ML for Video Metric Prediction



Content Type 1

Content Type 2

Content Type 3

Metadata extraction

- Bitrate
- Resolution
- Scene Changes
- Temporal & spatial complexities

Classification

Categories & Labels

Regression

Training Data

Database

Predicted [Bitrate, Resolution, Quality]

Convex Hull Estimation

Encoding Ladder

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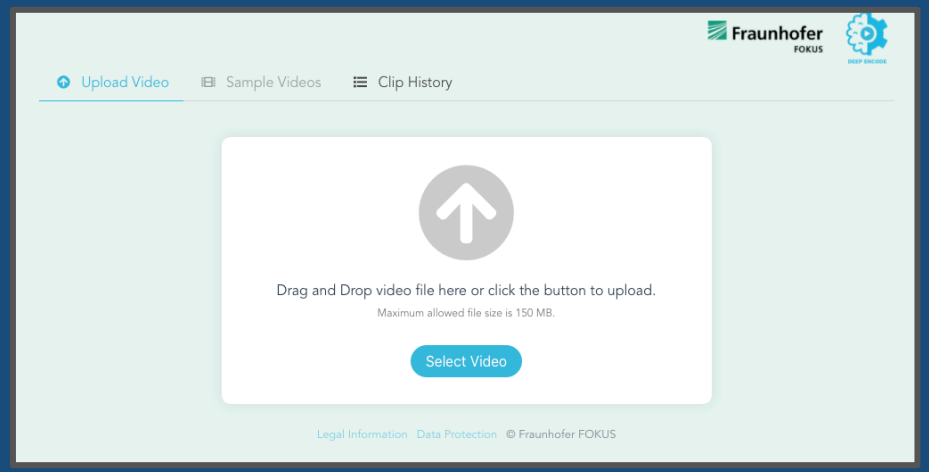
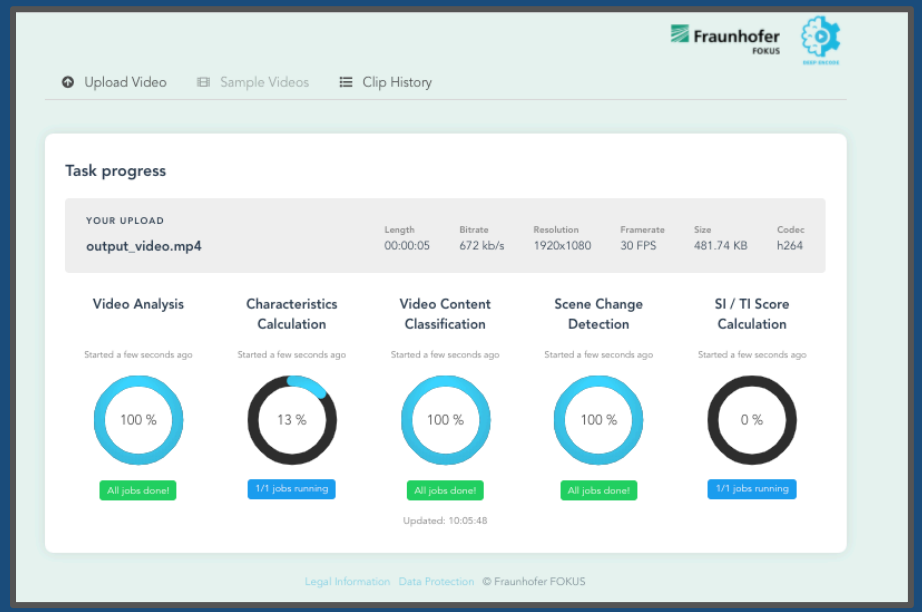
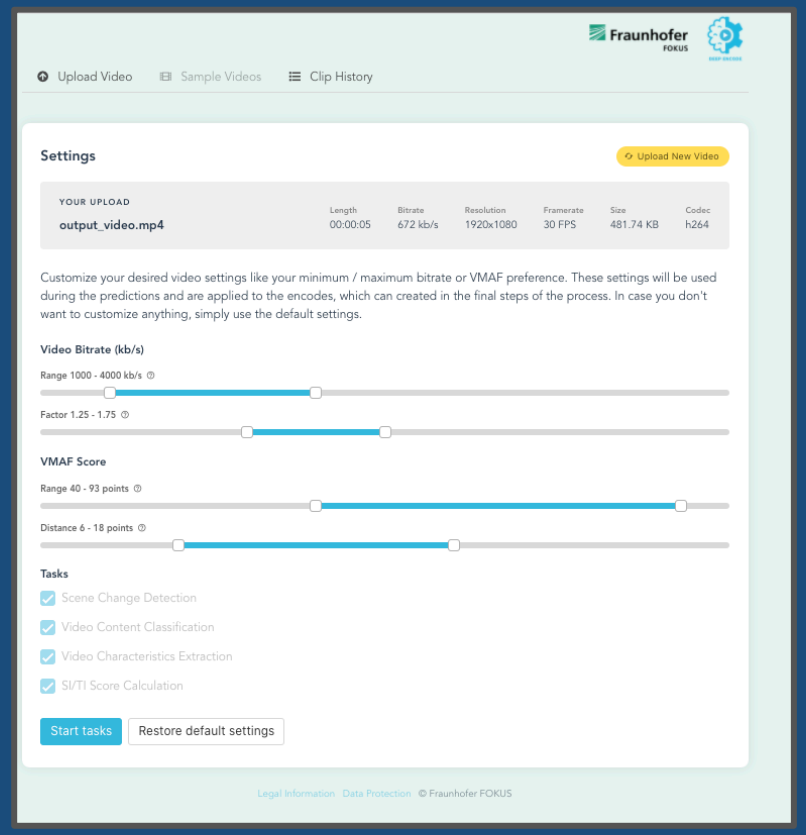
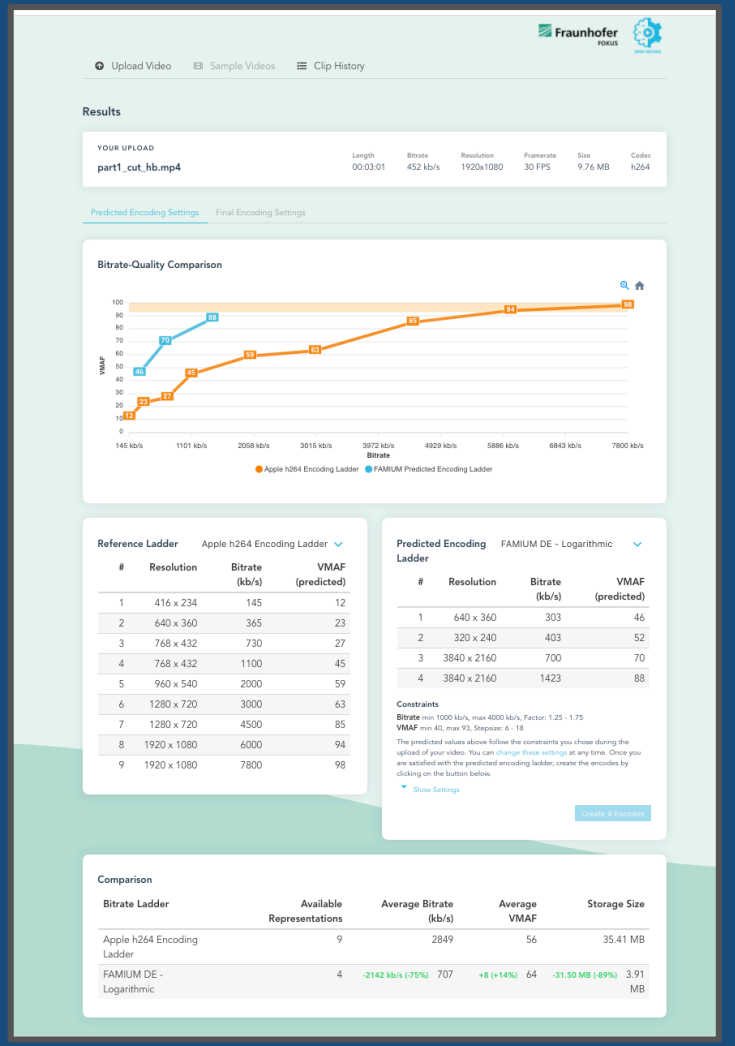
Deep Encode: Hands-on UI









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4 Summary, Outlook & Next Steps

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Deep Encode: Towards Context-Aware Encoding

Conventional Static Encoding

- **Same encoding ladder for all types of content**
  - Increased storage and delivery costs
  - "Waste" of quality
  - Lack of optimization for complex content

Conventional Per-Title Encoding

- Computationally heavy test encodes
- No dynamic reaction to complex scenes within a movie

Deep Encode

- ✓ **No computationally heavy test encodes**
- ✓ **Metadata extraction and AI-based image processing for content analysis**
  - Content categorization and labeling
  - Automatic scene detection
  - Metadata extraction
- ✓ **Deep Learning for optimal encoding ladders**
  - Prediction of [PSNR|VMAF, Bitrate] pairs
  - Dynamic prediction of the optimal encoding ladder
- ✓ **Enhancements**
  - Live-stream support
  - Per-scene and context-aware Encoding

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Thank you!

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FAME Video Development Blog: https://websites.fraunhofer.de/video-dev/

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