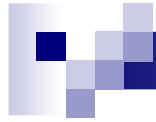


ViCoS

Video Codec and Video Filters Testing and Analysis System

System Description



Contents

- Overview
- Value Proposition
- System key features
 - Client-server architecture
 - DB usage
 - Robustness
 - Easy codec/preset addition
 - Results visualization
- Analysis
- Conclusions



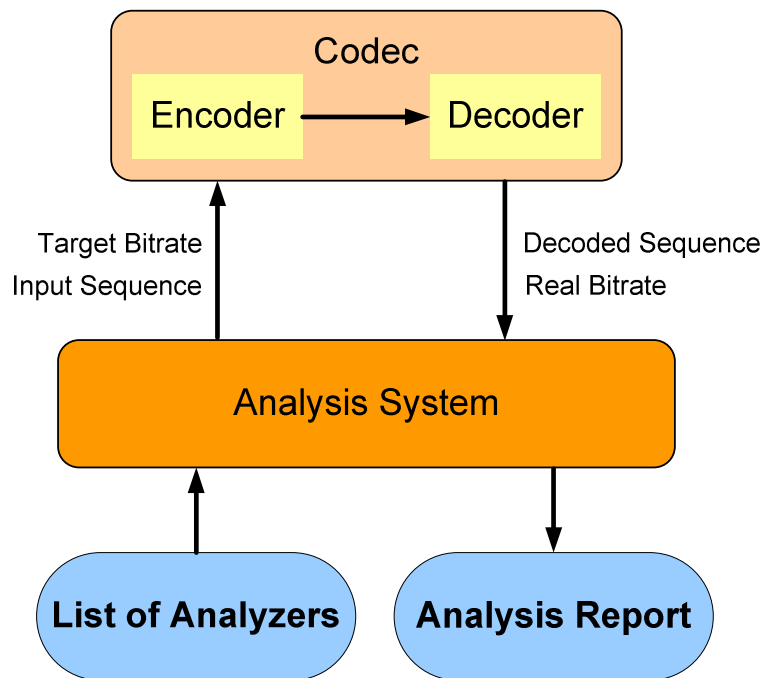
Overview

Main Purpose of the System

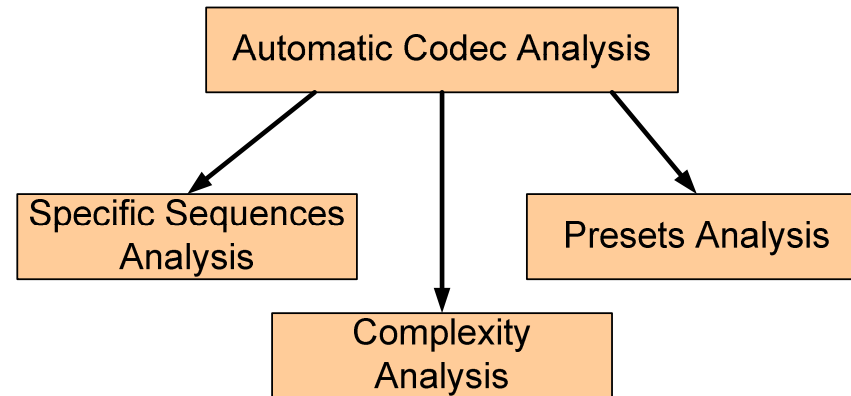
- Automatically evaluate quality of modern video codec and video filters using objective quality metrics and sequences modification.
- Both overall quality of the codec and quality of separate codec parts can be analyzed using the system.
- Same framework can be used for codec external options analysis and best presets automatically selection for given test set.

Overview

High Level View



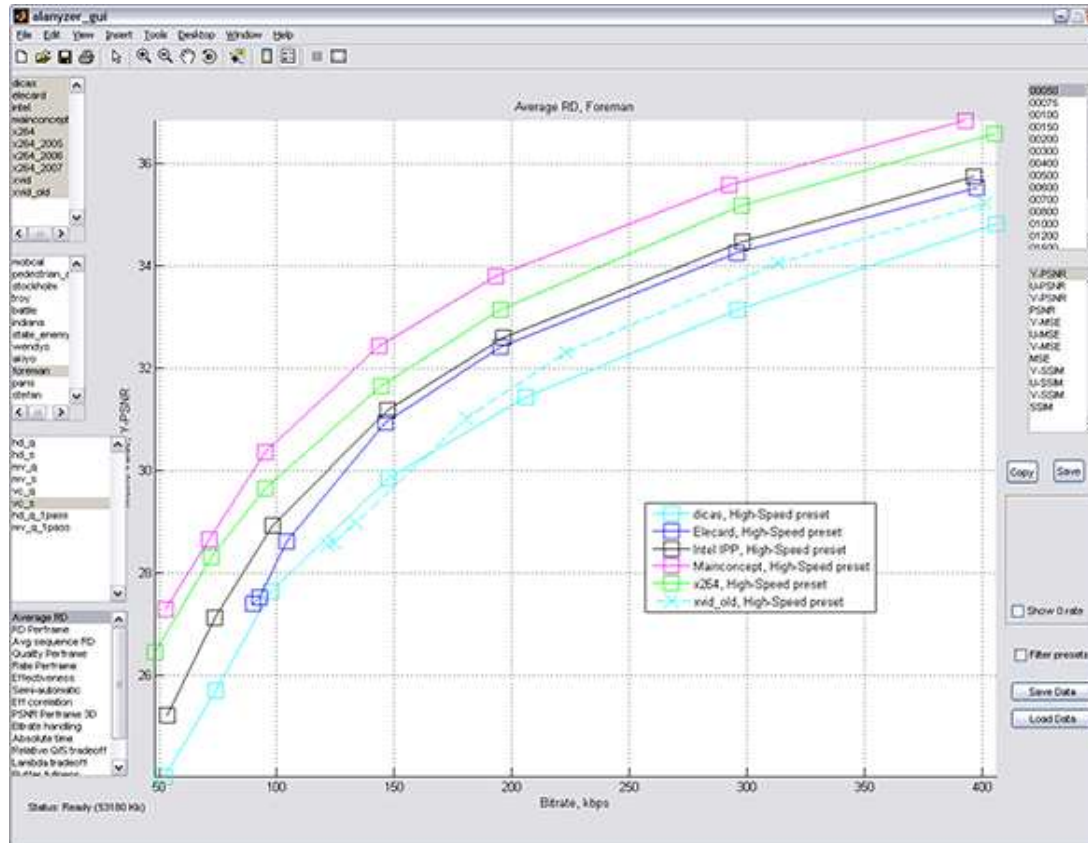
System Architecture



- Complexity analysis. Sequences with controllable complexity to analyze codec's quality reaction.
- Specific sequences analysis. Synthetic or modified natural sequence. Understanding the detailed structure of those sequences is the basis of analysis.
- Presets analysis. Automatically finding optimal presets using list of possible features. Analyzing codec's algorithm performance.

Overview

ViCoS Screenshots



Visualization framework

```

.....:
.....: MSU Video Coders Scoring System .....:
.....: 1.00 beta .....:
.....: MSU Graphics & Media Lab .....:
.....: Video Group .....:
.....: http://compression.ru/video/ .....:
.....:
Log: Reading sequence modification for file sequences\Foreman\Foreman_data
Log: Reading sequence modification for file sequences\low\low_data
Log: Reading sequence modification for file sequences\high\high_data
Warning: Can't load raw results from file "coders_results.dat"!
Log: Added codec analyzer "decoder_analyzer"
Log: Starting analyzer "decoder_analyzer"
Log: Launching codec: Cinecard, 2367, Foreman, 100...
Log: Starting decoder...
Log: Starting decoder...
Log: Calculating quality metrics...
Log: Raw metric results collection: Added new item (total 1 items)
Log: Raw launch results data collection: Added new item (total 1 items)
Log: Backup raw results...
Log: Launching codec: Cinecard, 2367, Foreman, 100...
Log: Starting decoder...
Log: Starting decoder...
Log: Calculating quality metrics...
Log: Raw metric results collection: Added new item (total 2 items)
Log: Raw launch results data collection: Added new item (total 2 items)
Log: Launching codec: Cinecard, 4654, Foreman, 100...
Log: Starting decoder...
Log: Starting decoder...
Log: Calculating quality metrics...
Log: Raw metric results collection: Added new item (total 3 items)
Log: Raw launch results data collection: Added new item (total 3 items)
Log: Launching codec: Cinecard, 4652, Foreman, 100...
Log: Starting decoder...
Log: Starting decoder...
Log: Calculating quality metrics...
Log: Raw metric results collection: Added new item (total 4 items)
Log: Raw launch results data collection: Added new item (total 4 items)
Log: Launching codec: Cinecard, 4658, Foreman, 100...
Log: Starting decoder...
Log: Starting decoder...
Log: Calculating quality metrics...

```

Working...

Codec analysis report

Log file: [log_file.txt](#)

Codec - xCode1, Preset - fast

Total mark: 51.07

Primary analyzers:

Analyzer name	Normalized score	Analyzer weight
chroma_me_analyzer	90.75	1.00
overall_analyzer	54.31	4.00
decimation_analyzer	27.86	0.50
motion_analyzer	32.83	2.00
blurring_analyzer	73.75	0.50
noise_frames_analyzer	77.96	0.50
noise_mb_analyzer	73.61	1.00
noise_spatial_analyzer	0.5	0.50
frame_rotation_analyzer	81.64	1.00
tail_area_analyzer	45.43	1.50
borders_analyzer	52.61	1.50
edge_capture_analyzer	0.00	1.00

Report example





Value Proposition

- Video codec developers
 - Automatic Quality Assurance
 - Comparison to competitors
 - Easy find weak points of codec
 - Construct best set of predefined presets
- Video codec users
 - Find the best codec for desired usage area
 - Find codec with desired speed/quality characteristics



System Key Features

Client-Server Architecture

- All codec, analyzers and metric launches could be parallelized by executing on different PC or cores of one PC
- Any PC could be a Server or a Client
- Shutdown of any client or even server does not lead to system crash or significant results lost – all the works could be continued after restart



System Key Features

Data Base Usage

- Results could be saved in Relational Data Base
- ViCoS supports almost any relational data bases management systems through ODBC mechanism:
 - MySQL
 - MSSQL
 - Oracle, etc



System Key Features

Robustness

- Codec failure does not lead to failures – the system continues to work, marking the error for this codec



System Key Features

Easy codec/preset Addition

- Unified codec description
- New codec, preset of video sequence addition required user to spend approximately 1 minute



System Key Features

Results Visualization

- All obtained results could be visualized very easily
- One of the way – special MATLAB framework (could be included in ViCoS delivery) to choose different types of analyzers/metrics/bitrates etc. and types of graphs



System Key Features

Huge Amount of Data Processing

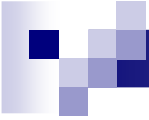
- During ViCoS work huge amount of data is produced
- It is processed and categorized very easily and user friendly comparing to set of scripts and batch files, used by codec developers themselves



System Key Features

Specific Analysis Types

- ViCoS uses specific type of analysis:
 - well-known (objective metrics)
 - specially developed for the system
 - Edge capture
 - Borders quality
 - Tail area
 - Blurring
 - Synthetic motion
 - And more than 10 other types



Analysis

Examples

- Complexity analysis
 - Generate sequences with controllable encoding complexity to analyze codec efficiency using relative marks changing for different complexity values
 - “Encoding complexity” - different for rate control, ME, define relative complexities for some subset of video sequences
 - “Relative marks” – codecs is not easy to compare, use reference codec to produce reference RD curve and calculate average relative bitrate for the same quality
- Sequences Modifications and Encoding Complexity
 - What codec/bitrate/encoding parameters should we choose to be correct?
 - Synthetic sequences
 - Frames removal from natural sequence
 - Blurred sequence
 - Replacing some frames of sequence with random uniform noise
 - etc...
- Specific Sequences Analysis
 - Moving object tail area, edge capture/distortion
- Overall Quality Analysis
 - Combination of metrics, temporal characteristics of per-frame metrics results



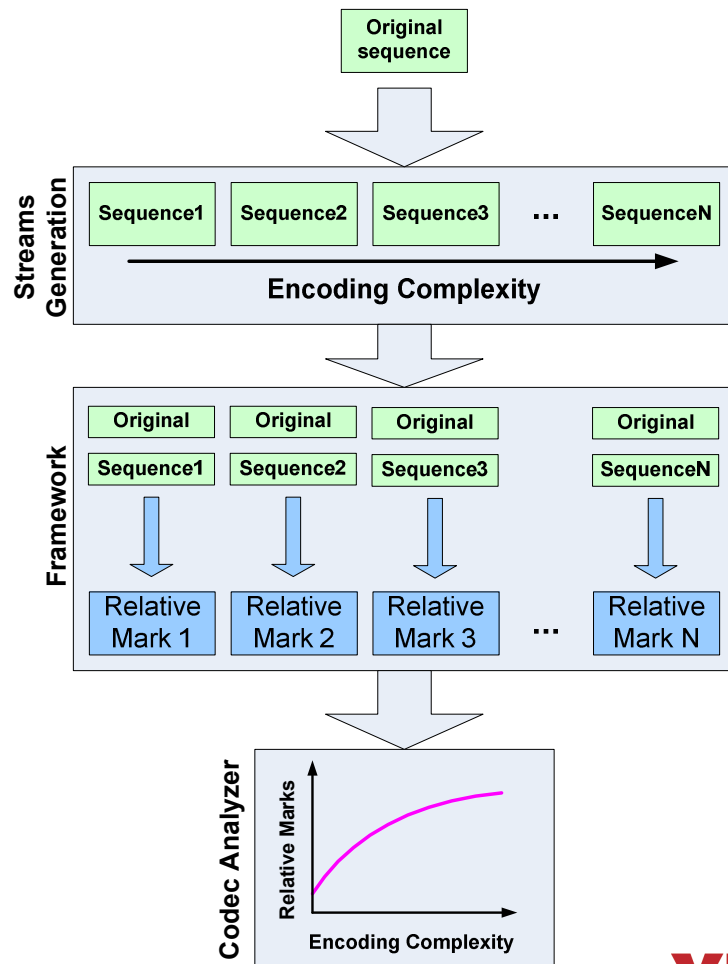
Analysis

List of analyzers

<i>Analyzer</i>	<i>Type of Sequences</i>	<i>Target Codec Parts</i>
Decimation	Complexity Modifications	ME, Mode Decision
Blurring	Complexity Modifications	Mode Decision, Sub-MB RC
Noise Frames	Complexity Modifications	Frame-level RC
Noise MB	Complexity Modifications	MB-level RC
Spatial Noise	Complexity Modifications	MB-level RC
Chroma ME	Sequences Modifications	ME using chroma components
Frames Rotating	Sequences Modifications	ME imperfections
Tail Area	Synthetic Sequence	MB-level RC
Edge Capture	Synthetic Sequence	ME, Mode Decision
Synthetic Motion	Synthetic Sequence	ME
Borders Quality	Synthetic Sequence	ME, MB-level RC
Overall Quality	Original Sequences	All parts balance

Analysis

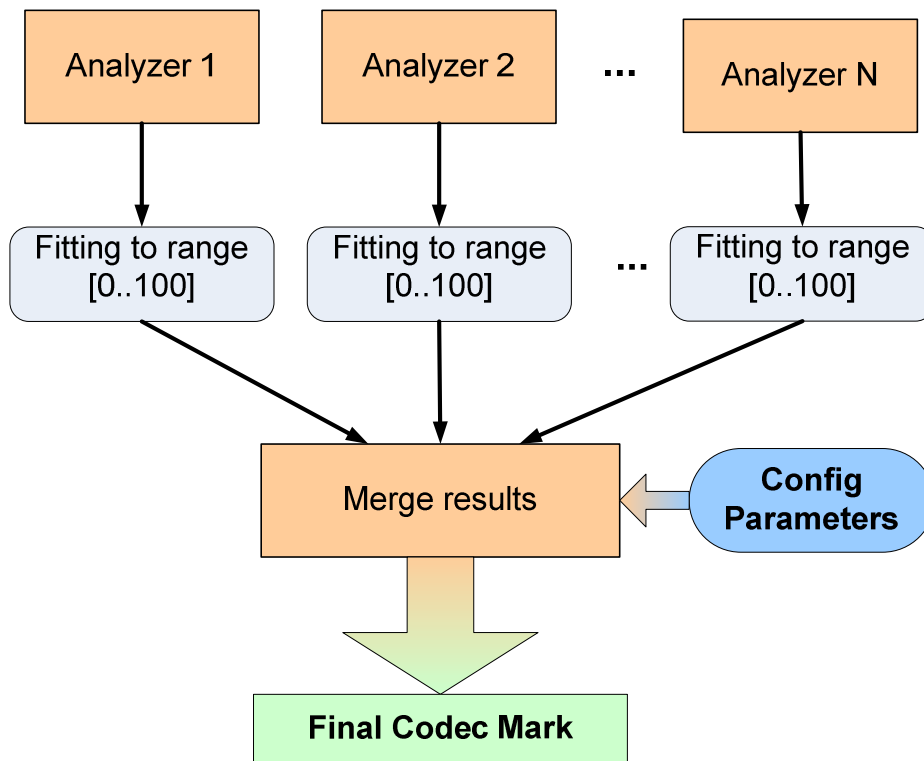
Common Approach in Complexity Modifications



- Frames decimation analyzer
- Blurring analyzer
- Noise frames analyzer
- Noise macroblocks analyzer
- Spatial noise analyzer

Analysis

Final Marks Construction



- Get results from each analyzer
- Fit results to range [0..100]
- Merge results
- Merging - linear combination



Analysis

Optimal Presets Estimation – Use Cases

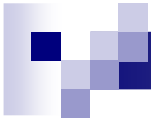
- Find optimal presets for different encoding speed
- Find the best preset with fixed speed (quality) for competitive analysis
- Choose optimal presets for particular customer conditions (type of sequences, hardware architecture)
- Analysis of codec features performance



Analysis

Optimal Presets Estimation – Technical Details

- Simple language to describe possible codec parameters
- Several algorithms for best preset selection (not simple full search)
- Progressive results obtaining is possible (more resources -> better presets)



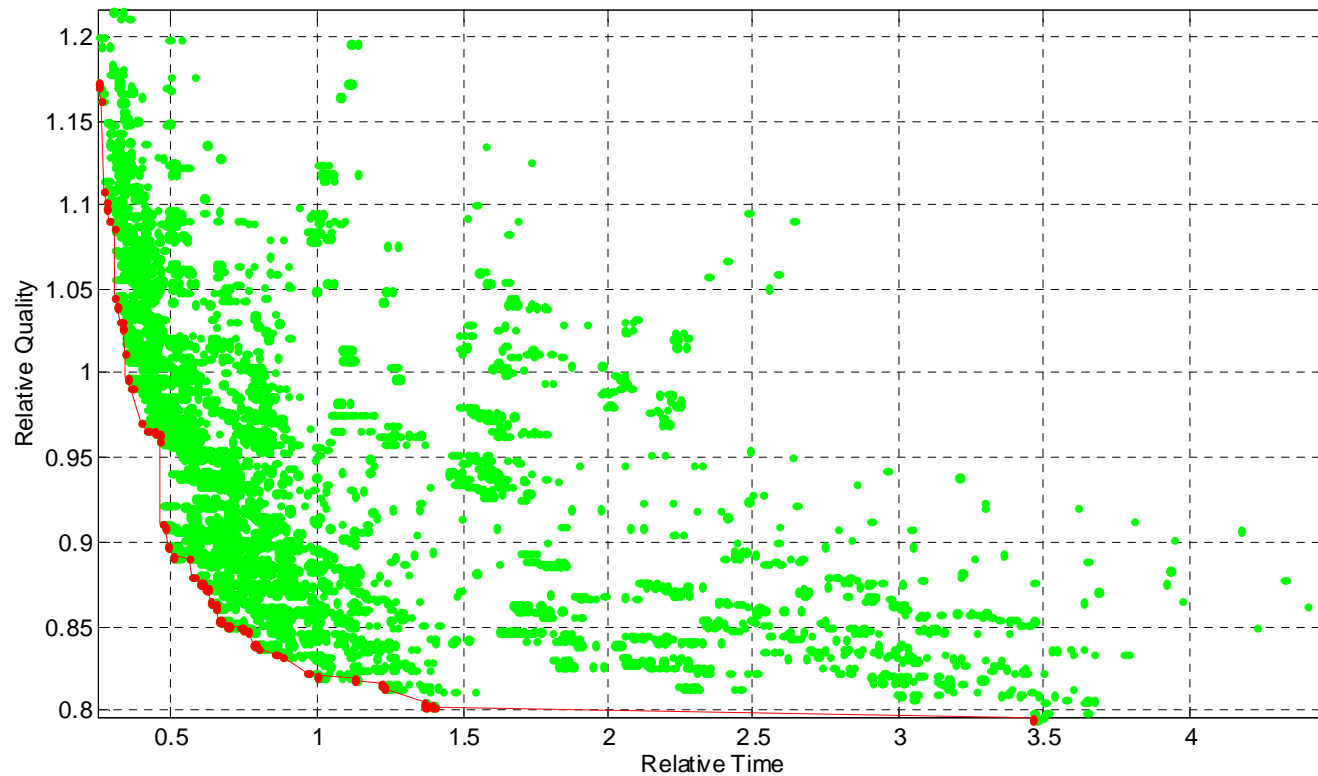
Analysis

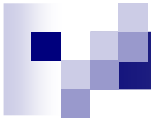
Optimal Presets Estimation – Examples

Each green point is tested preset

Red line consists of selected optimal presets

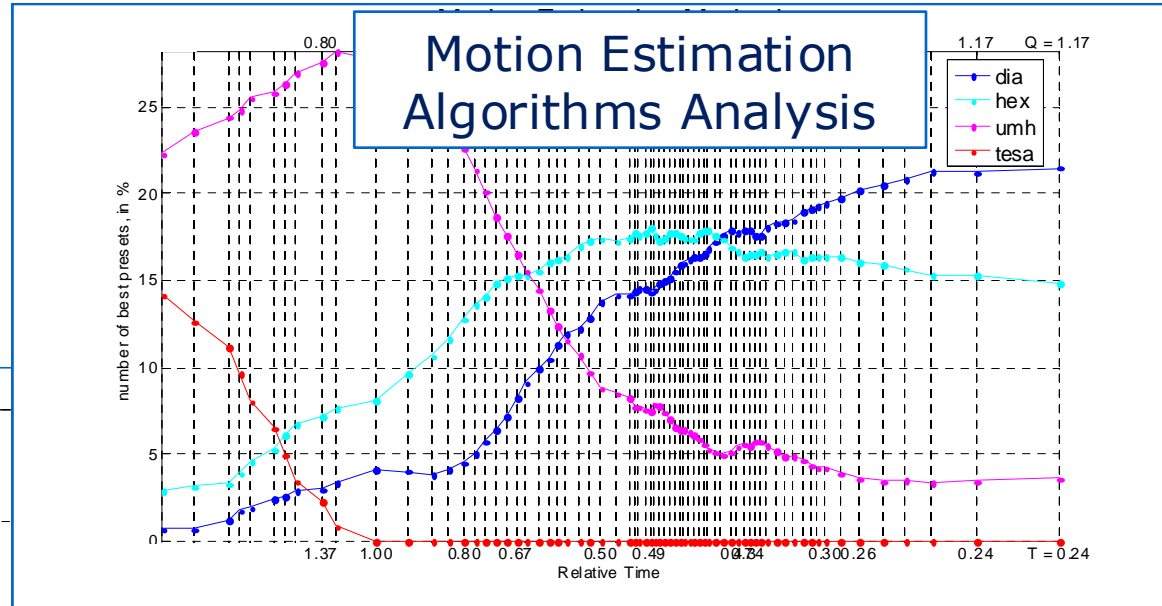
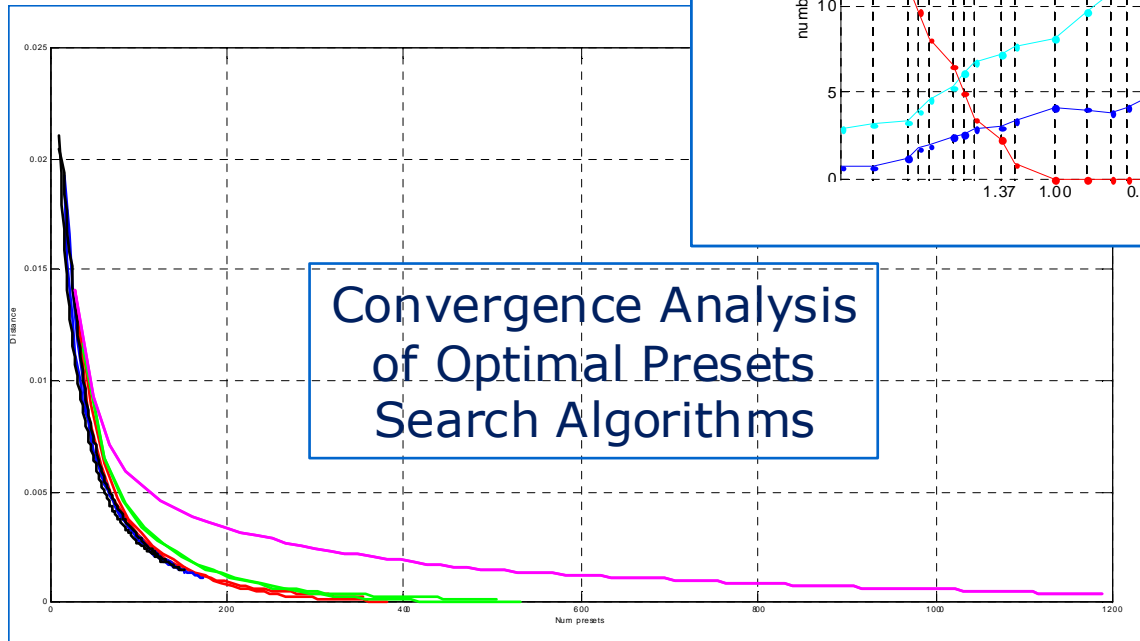
Sub-optimal Presets





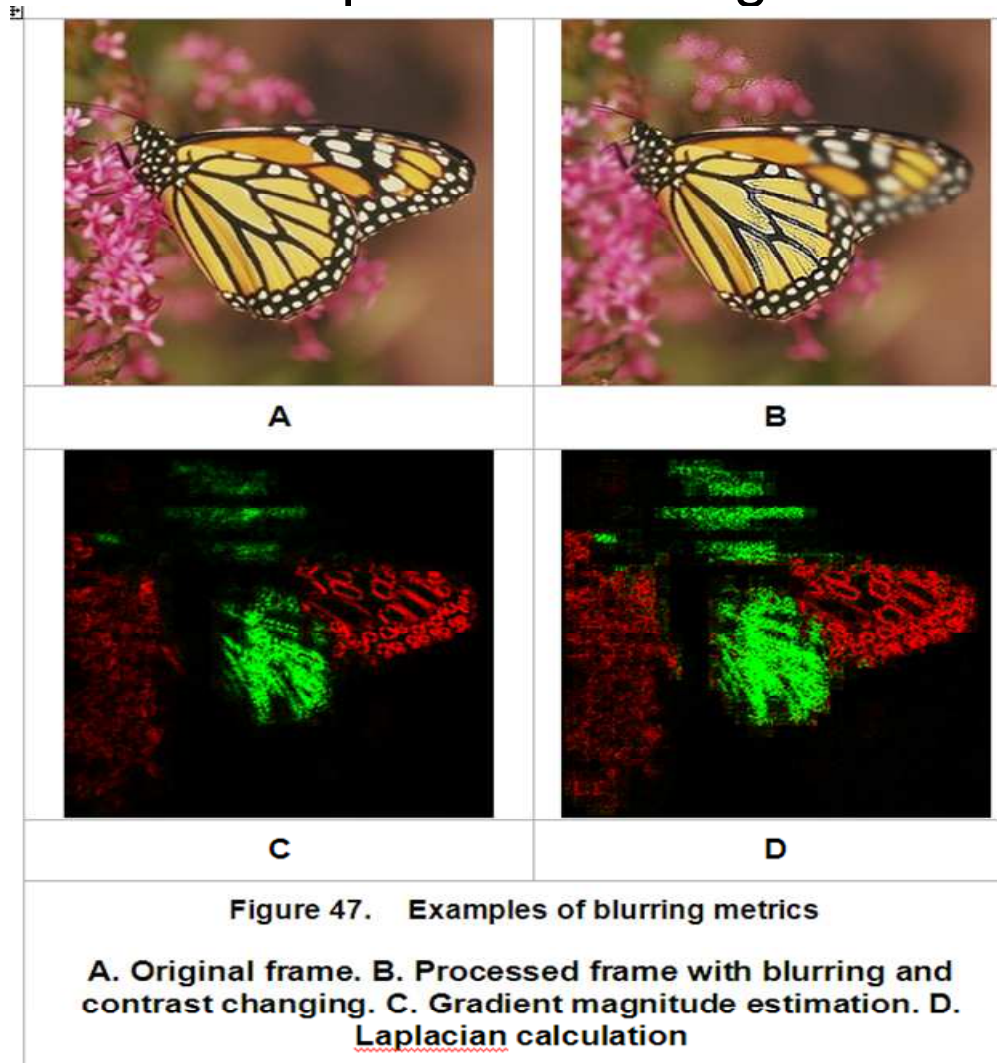
Analysis

Optimal Presets Estimation – Examples (2)



Analysis

Examples of Blurring Metric

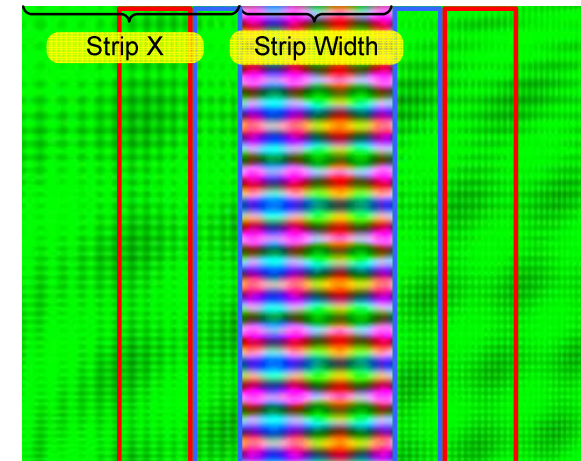
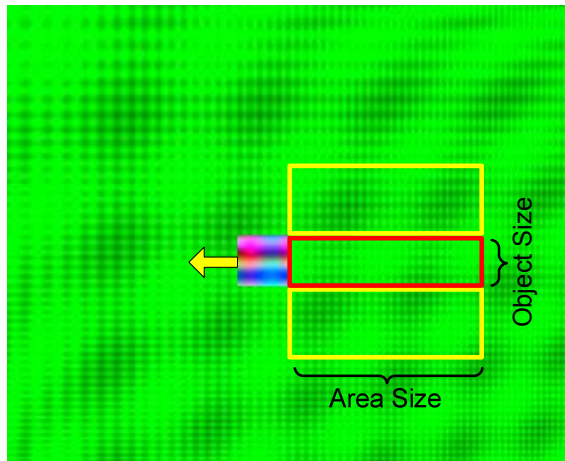


Analysis

Examples of Metrics:

Border Quality, Tail Area and Edge Capture Quality Metric

- Metrics for synthetic sequences:
 - Borders quality metric
 - Tail area metric
 - Edge capture metric
- These metrics are represented in the system in ordinary way
- In fact metrics are independent from analyzers

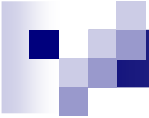


Analysis

Examples

- Codecs:
 - x264 (9 presets)
 - XviD (1 preset)
- Sequences
 - Foreman
 - Flower
 - Bus

<i>Codec/preset</i>	<i>Final Mark</i>
x264/SUBME 7	59.93
x264/ME_ESA	57.91
x264/ME_UMH	55.98
x264/ANALYZE_ALL	53.93
x264/REF_4	51.59
x264/ME_DIA	49.70
x264/SLOW	49.17
x264/ANALYZE_NONE	48.67
XviD	46.29
x264/FAST	42.48



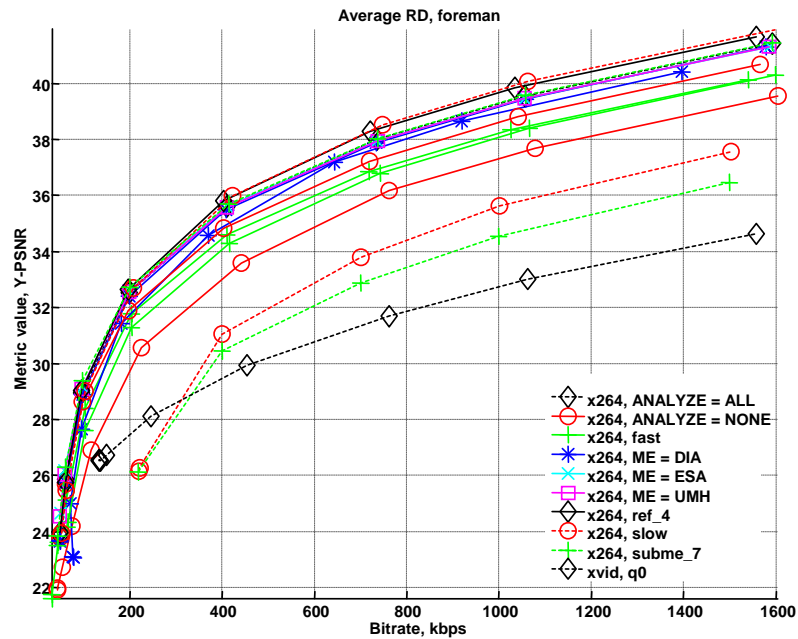
Analysis

Examples (2)

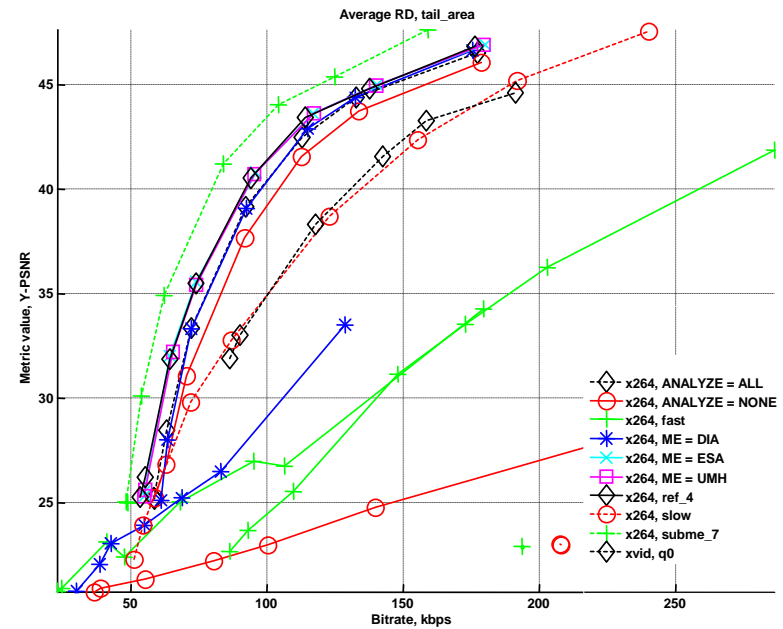
<i>Analyzer</i>	<i>x264/FAST</i>	<i>XviD</i>
Frame Rotation	90.01	50.73
Overall	37.25	0.00
Decimation	15.07	83.92
Synthetic Motion	50.00	50.00
Blurring	30.45	60.12
Noise Frames	85.13	100.00
Noise MB	34.18	75.79
Noise Spatial	48.97	63.38
Chroma ME	33.90	69.27
Tail Area	68.10	0.00
Borders Quality	16.72	2.31
Edge Capture	0.00	0.00

Analysis

Examples (3)



All codecs, Foreman



All codecs, Synthetic Motion



Conclusions

- Fully automatic complex codec analysis system, including
 - Specific analysis types
 - Client-server architecture
 - DB usage
 - Robustness
 - Easy codec/preset addition
 - Results visualization
 - etc.



Contact Information

- WWW: <http://www.yuvsoft.com/technologies/vicos>
- E-mail: vicos@yuvsoft.com
- Phones:
 - +1-(408)-426-5988
 - +7-(906)-744-0865