MSU Perceptual Video Quality Tool Documentation (PRO version 2.0 BETA)

August 2018
CS MSU Graphics & Media Lab
Video Group
http://www.compression.ru/video/

How to use PVQT

What is PVQT?

PVQT is a tool, developed by MSU Graphics & Media Lab. Video Group for evaluating of subjective quality (with reference or without one) of a video and image files.

The tool was developed according to ITU-R BT.500 “Methodology for the subjective assessment of the quality of television pictures”. The program does not exactly repeat the standard, as it is focused on the measurement of quality for television, but PVQT is aimed for quality measure of digital materials. Also, it have some additional features not described in the standard.

PVQT structure

PVQT consists of 2 basic parts:

- **Editor** (MSU PVQT) — for creating a test and collecting results (see section **Creating a test**),
- **Player** (MSU PVQT Player) — for performing (playing) test by observer or operator in case of Network test (see section **Passing a test**).

How to use it?

To prepare quality-measure process, you need:

- Reference video or image files (not for all methods), SRC
- Processed (distorted) video or image files,
- Sufficient number of observers, that are not an experts (BT.500 recommends at least 15 observers)

To perform test, you should:

- Choose method of testing according to section **Methods**,
- Create PVQT test (*.pvqt file) according to section **Creating a test**,
- Choose method of performing test and organize testing according to **Organization of testing** section,
- Instruct observers according to **Passing a test** section and perform test,
- Collect and process results according to **Results inspection** section.

Technical recommendations

PVQT now available only for Windows operating system, starting from Windows 7.
Recommended amount of RAM:

- 0.5GB for 2k video,
- 1.5GB for 4k video.

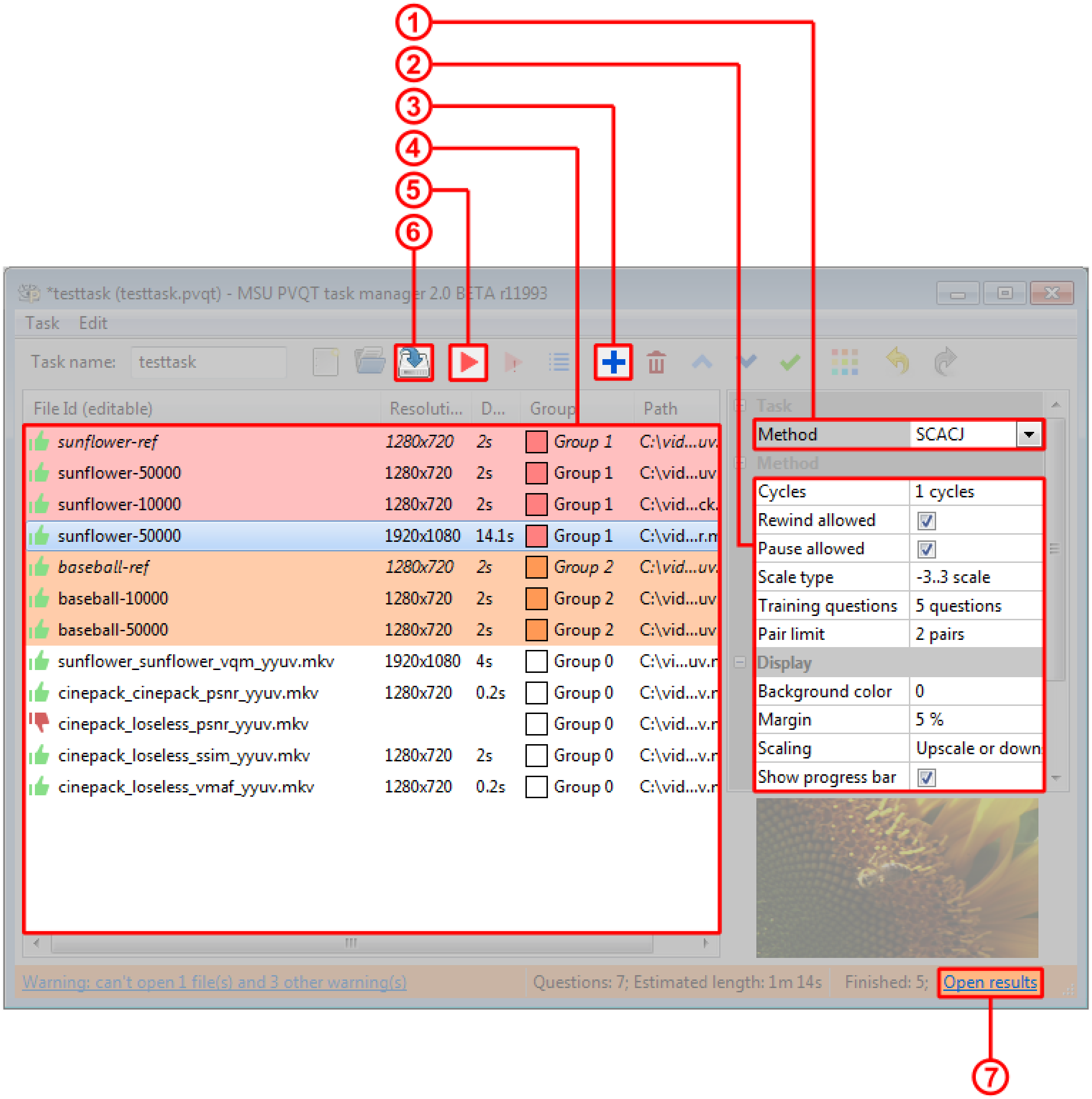
Supported formats

Supports all video formats of FFmpeg 2.7 (more than 300 video formats).
Supported image formats: bmp, gif (not animated), jpeg, png, tiff, pcx, pnm, tga, xpm.

Creating a test

Step-by-step instructions

Run PVQT editor. You will see editor main Window. Follow this step-by-step instruction to create a task.



*testtask (testtask.pvqt) - MSU PVQT task manager 2.0 BETA r11993

Task name: testtask

File Id (editable)	Resoluti...	D...	Group	Path
sunflower-ref	1280x720	2s	Group 1	C:\vid...uv.
sunflower-50000	1280x720	2s	Group 1	C:\vid...uv
sunflower-10000	1280x720	2s	Group 1	C:\vid...ck.
sunflower-50000	1920x1080	14.1s	Group 1	C:\vid...r.m
baseball-ref	1280x720	2s	Group 2	C:\vid...uv.
baseball-10000	1280x720	2s	Group 2	C:\vid...uv
baseball-50000	1280x720	2s	Group 2	C:\vid...uv
sunflower_sunflower_vqm_yyuv.mkv	1920x1080	4s	Group 0	C:\vi...uv.r
cinepack_cinepack_psnr_yyuv.mkv	1280x720	0.2s	Group 0	C:\vid...v.r
cinepack_loseless_psnr_yyuv.mkv			Group 0	C:\vid...v.r
cinepack_loseless_ssim_yyuv.mkv	1280x720	2s	Group 0	C:\vid...v.r
cinepack_loseless_vmaf_yyuv.mkv	1280x720	0.2s	Group 0	C:\vid...v.r

Task	
Method	SCACJ
Method	
Cycles	1 cycles
Rewind allowed	☑
Pause allowed	☑
Scale type	-3..3 scale
Training questions	5 questions
Pair limit	2 pairs
Display	
Background color	0
Margin	5 %
Scaling	Upscale or down
Show progress bar	☑

Warning: can't open 1 file(s) and 3 other warning(s) | Questions: 7; Estimated length: 1m 14s | Finished: 5; Open results

1. *Select method*
   You can find help about each method bellow property grid frame. Or refer to section "Methods".

2. *Choose settings*
   "Method" section contains properties, specific for selected method. "Display" section shows, how the video files will be displayed at screen. "File" section contains properties that affect the ability to send a project and collect results.

3. *Add video files to project*

   You can add files via Menu, ➕ on toolbar, or Drag & Dropping files into file list. You can select multiple video files in file dialog.

4. *Check and organize files*
   Successfully loaded files are marked with 👍, if there are some problems, file is marked with 👎. Please, don't leave 👎 files in task, they will break execution.

   Also, you can order files via ⌃ and ⌄, *group* them via ▦, and set *references* via ✓.
   All these operations are possible also for multiple of files.
   References demanded by some methods (you should select exactly one reference in each group). During execution files will be compared with other files of the same *group*.
   Change IDs of files (first column in file list). When you will save and organize results, each file will be identified by it's ID.

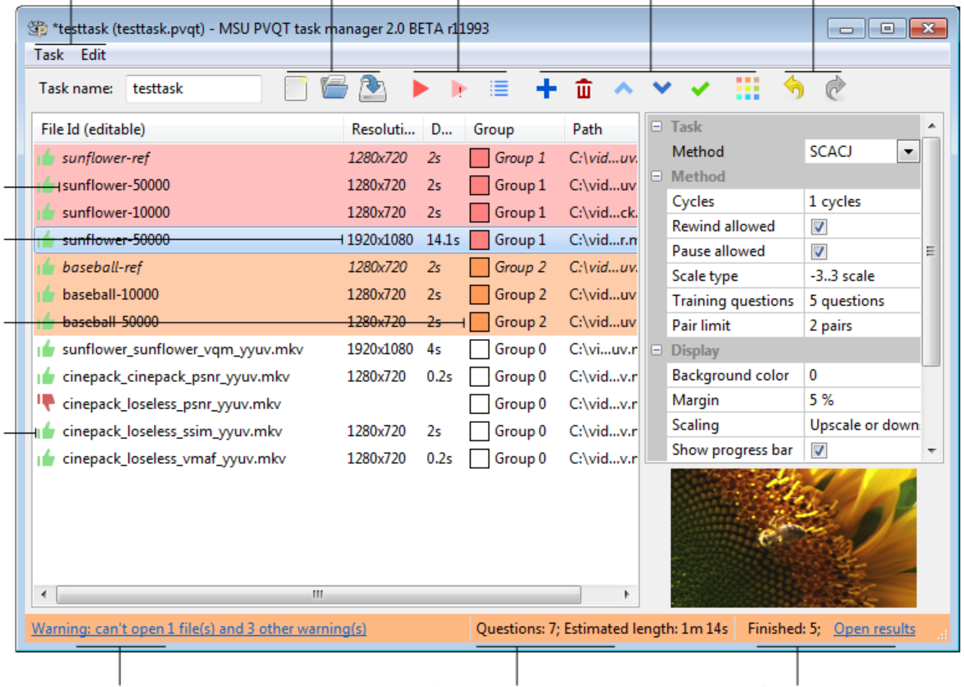
5. *Debug test to find all possible issues*
   Debugging mode allows you to run test without saving any results. You can interrupt debugging at any moment. Also, you can run test (🚩) from editor window to do real test with saving results. You should save project before running.
   You can't run or debug test if you have errors in it. Errors are shown in status bar. Click on link in status bar to know more about project messages.

   NOTE: when you do debug or run, the settings currently in editor window will be taken into account. It can be different from saved file.
   IMPORTANT: If you have unfinished task, it will be erased if you start running from editor window. To resume unfinished pass run test via player.

6. *Save test, and send it to observers*
   Save test via menu, toolbar or hotkey. PVQT saves history of files. See section "Organization of testing" for more info.

7. *After some experts passed a test, inspect the results*
   You can see brief results and information about current executions in statusbar third segment. PVQT monitor will display results in real time. If PVQT unable to establish real-time monitor, there also "Refresh" link appears. You can open the detailed result window via statusbar link or ☰. More in section "Results inspection"

Editor Main window basic controls description



*testtask (testtask.pvqt) - MSU PVQT task manager 2.0 BETA r11993
Task
Edit

Task name: testtask

	File Id (editable)	Resoluti...	D...	Group	Path
👍	*sunflower-ref*	*1280x720*	*2s*	🟥 *Group 1*	*C:\vid...uv.*
👍	sunflower-50000	1280x720	2s	🟥 Group 1	C:\vid...uv
👍	sunflower-10000	1280x720	2s	🟥 Group 1	C:\vid...ck.
👍	sunflower-50000	1920x1080	14.1s	🟥 Group 1	C:\vid...r.m
👍	*baseball-ref*	*1280x720*	*2s*	🟧 *Group 2*	*C:\vid...uv.*
👍	baseball-10000	1280x720	2s	🟧 Group 2	C:\vid...uv
👍	baseball-50000	1280x720	2s	🟧 Group 2	C:\vid...uv
👍	sunflower_sunflower_vqm_yyuv.mkv	1920x1080	4s	□ Group 0	C:\vi...uv.r
👍	cinepack_cinepack_psnr_yyuv.mkv	1280x720	0.2s	□ Group 0	C:\vid...v.r
👎	cinepack_loseless_psnr_yyuv.mkv			□ Group 0	C:\vid...v.r
👍	cinepack_loseless_ssim_yyuv.mkv	1280x720	2s	□ Group 0	C:\vid...v.r
👍	cinepack_loseless_vmaf_yyuv.mkv	1280x720	0.2s	□ Group 0	C:\vid...v.r

Task	
Method	SCACJ
Method	
Cycles	1 cycles
Rewind allowed	☑
Pause allowed	☑
Scale type	-3..3 scale
Training questions	5 questions
Pair limit	2 pairs
Display	
Background color	0
Margin	5 %
Scaling	Upscale or down
Show progress bar	☑

Warning: can't open 1 file(s) and 3 other warning(s) | Questions: 7; Estimated length: 1m 14s | Finished: 5; Open results

Menu Bar
Access to basic functions and file history. Hotkeys for basic operations

File tools
New & Save & Load task

Task tools
View results & Debug & Play

File list tools
Add & Remove & Set reference & Set group & Move Up & Down

Undo & Redo
50-items history

Editable file ID
This ID will be presented in results

Video basic info
Resolution and duration

Grouping
Groups allows you to mix different images in one task. User will compare video from single group

Correctness flag
Shows whether the video was opened

Messages summary
click to view all warnings, errors, notices. Errors restics test play or debug, warnings indicate the violation of ITU.R BT500 or other issues

Test summary
total number of questions in test and estimated length

Results summary
real-time information about passed tests. Click to open detailed statistics and view results

Editor main window elements description

Methods

Method determines the order in which the video is displayed, which question will be asked to the observer, and how the results will be processed. The methods used are described in recommendations and standards.

Each method has additional configuration, available in Method section of property grid of Editor.

DSIS — Double Stimulus Impairment Scale

(see ITU-R BT.500)
Videos are shown consequently in pairs: first video is the reference (expert is informed about it), second video is an impaired.

Using references and cycles

Each video will be compared to the reference of its group during one cycle. You can increase number of cycles, and observer will see the same question several times. If “Shuffle sources” is on (recommended) videos will be presented in random order.

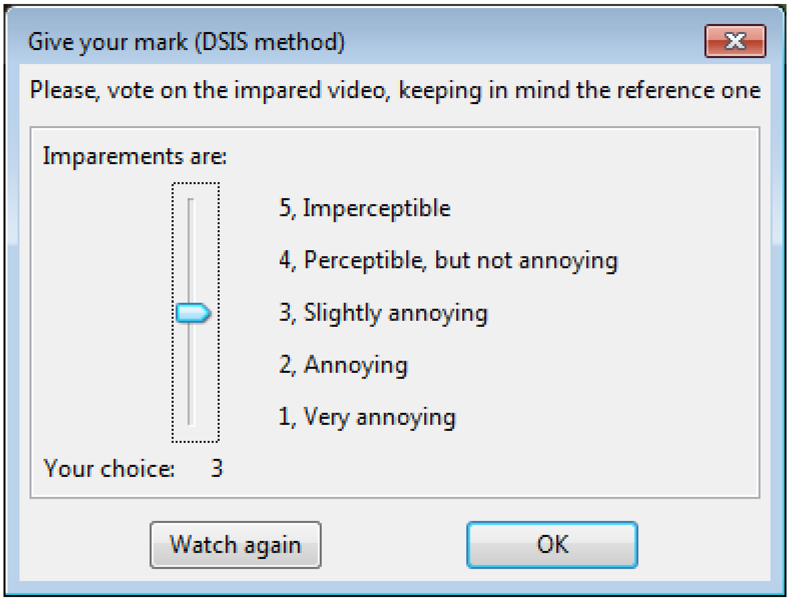
Training questions

The selected number of random “training” questions will be added to beginning of test to stabilize observer’s opinion. Their results will be discarded.

Question order and ranking

After playback, observer is asked to evaluate distorted video using impairment scale.

Vote window view



Give your mark (DSIS method)

Please, vote on the impared video, keeping in mind the reference one

Imparements are:

5, Imperceptible
4, Perceptible, but not annoying
3, Slightly annoying
2, Annoying
1, Very annoying

Your choice: 3

DSCQS I — Double Stimulus Continuous Quality Scale Type I

(see ITU-R BT.500)
In one playback window expert is free to switch between two videos. One of videos is the reference one, but an expert is not informed about it.

Using references and cycles

Each video will be compared to the reference of its group during one cycle. You can increase number of cycles, and observer will see the same question several times. If “Shuffle sources” is on (recommended) videos will be presented in random order.

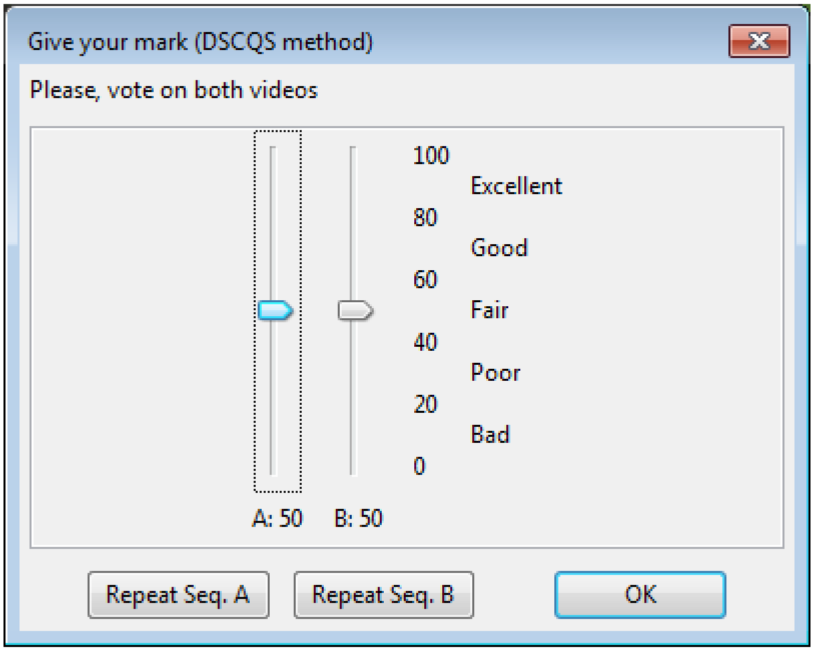
Training questions

The selected number of random “training” questions will be added to beginning of test to stabilize observer’s opinion. Their results will be discarded.

Question order and ranking

After playback, observer are asked to evaluate both videos (hidden reference and distorted). The destination rank is difference between two answers.

Vote window view



Give your mark (DSCQS method)

Please, vote on both videos

DSCQS II — Double Stimulus Continuous Quality Scale Type II

(see ITU-R BT.500)
Videos are played simultaneously (side-by-side) a given amount of times (repetitions), one is the reference one, but an expert is not informed about it.

Using references and cycles

Each video will be compared to the reference of its group during one cycle. You can increase number of cycles, and observer will see the same question several times. If “Shuffle sources” is on (recommended) videos will be presented in random order.

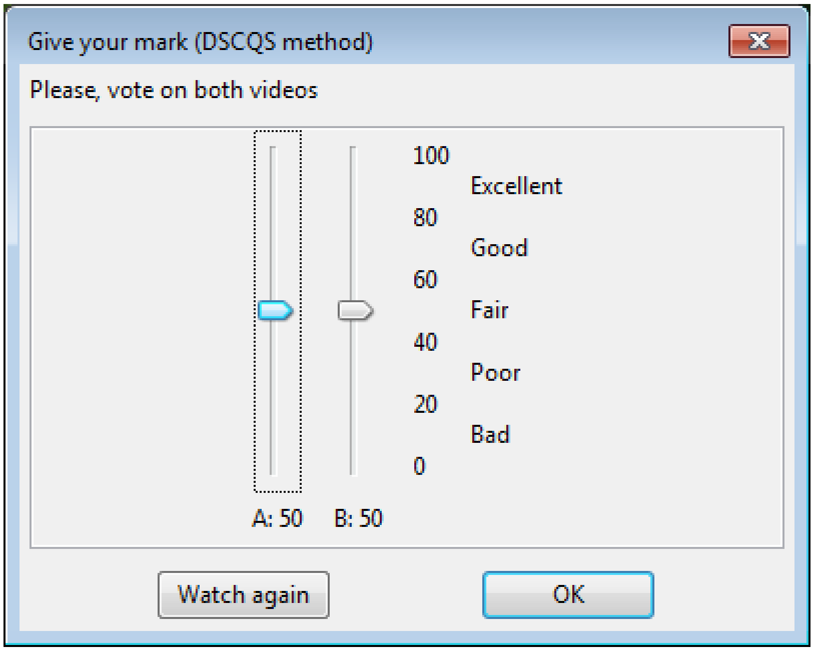
Training questions

The selected number of random “training” questions will be added to beginning of test to stabilize observer’s opinion. Their results will be discarded.

Question order and ranking

After playback, observer are asked to evaluate both videos (hidden reference and distorted). The destination rank is difference between two answers.

Vote window view



Give your mark (DSCQS method)

Please, vote on both videos

SCACJ — Quality evaluation using categorical scale

(see ITU-R BT.500)
Two videos are shown simultaneously, after playback expert is asked about his opinion.

Using references and cycles

This test does not use references. Each video is compared to each video of its group in one cycle. You also can limit pairs in one cycle. Pairs in one cycle are not repeated.

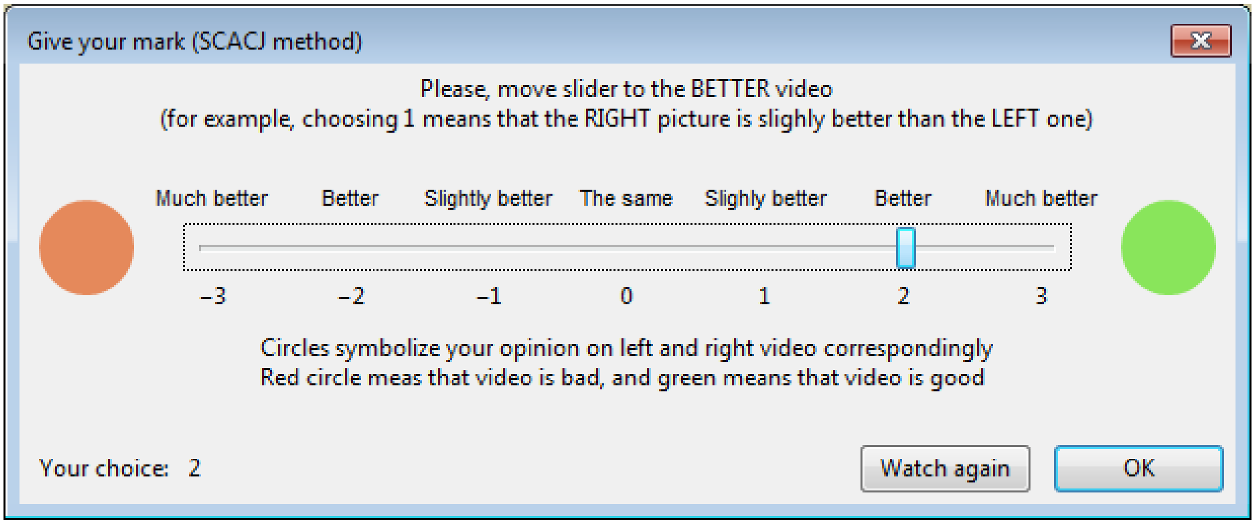
Training questions

The selected number of random “training” questions will be added to beginning of test to stabilize observer’s opinion. Their results will be discarded.

Question order and ranking

After playback, observer are asked to select better video. You can choose: binary or 7-grade scale (-3..3). Results are saved for pair, then mark to each video are given according to Bradley-Terry model.

Vote window view



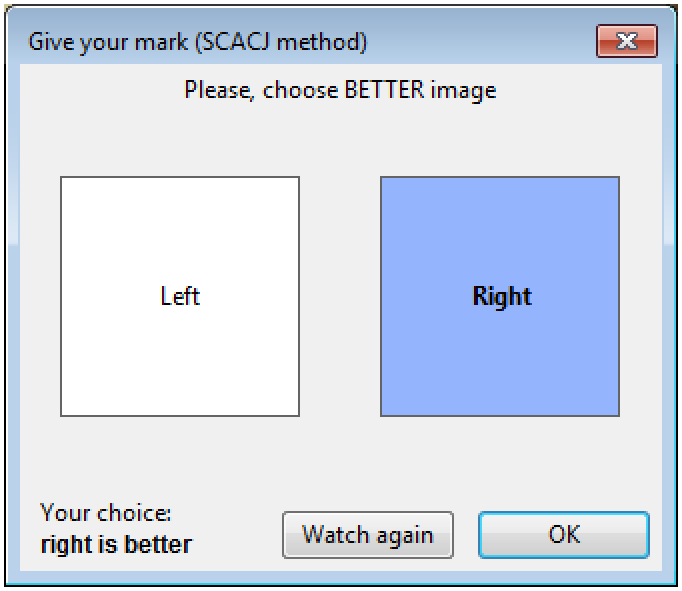
Give your mark (SCACJ method)

Please, move slider to the BETTER video
(for example, choosing 1 means that the RIGHT picture is slighly better than the LEFT one)

Circles symbolize your opinion on left and right video correspondingly
Red circle meas that video is bad, and green means that video is good

Your choice: 2

For 7-grade scale



Give your mark (SCACJ method)

Please, choose BETTER image

Your choice:
right is better

For binary scale

SAMVIQ — Subjective Assessment Method for Video Quality evaluation

(see “Subjective quality of internet video codecs - Phase 2 evaluations using SAMVIQ”)
Expert is able to play any sequence from the test set and give it mark, plus expert is able to play reference video.

Using references and cycles

Each video will be compared to the reference of its group. Cycles are not relevant for this method. Order of videos is determined by the observer, but observer should firstly evaluate all videos of the first presented group, then the second presented groups, etc. Observer can proceed to the next group only when marks are given to all videos of previous group.
There is a hidden reference among all distorted videos. Also, observer can watch explicit reference.

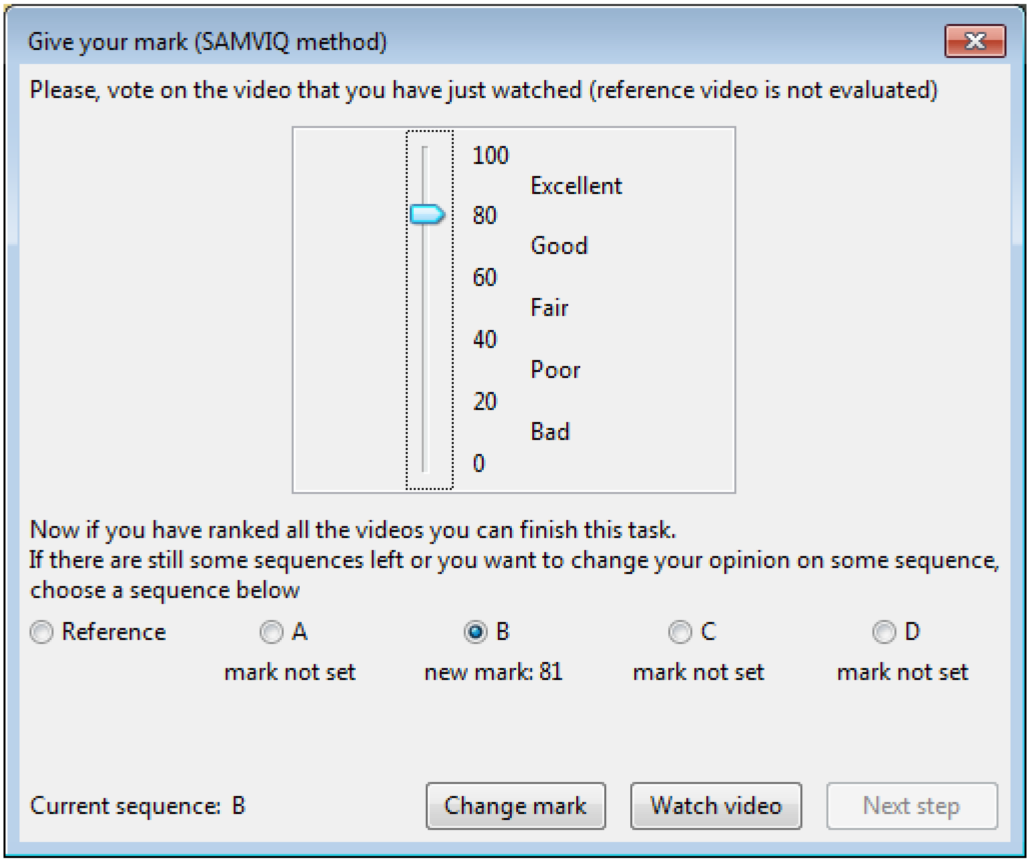
Training questions

No training questions are supposed by this method since user can change a mark. You can manually add a dummy group whose results will not be taken into account.

Question order and ranking

After playing each video except explicit reference, observer can mark it. Also, observer can change marks for previously watched videos. We use continuous (0..100) scale for this method.

Vote window view



Give your mark (SAMVIQ method)

Please, vote on the video that you have just watched (reference video is not evaluated)

Now if you have ranked all the videos you can finish this task.
If there are still some sequences left or you want to change your opinion on some sequence, choose a sequence below

○ Reference	○ A	● B	○ C	○ D
	mark not set	new mark: 81	mark not set	mark not set

Current sequence: B

Organization of testing

General rules

Transmitting project to another location
No videos or other files from file list are stored in PVQT project file. You should take care of the availability of these files when passing the test by an observer

If you turned on “Relative paths” in editor and all files are on the same partition with project file, you can move project file (*.pvqt) with files to another location or computer keeping relative paths. If some or all files are in network locations (such as shared folder), you can move project file to computer which has access to that network locations.

Also, if “Relative paths” is on, you can run project from another computer via shared folder. You don’t need to copy project or videos to another computer if both are available over shared folders.

If “Relative paths” is off, you can move project file to another location on the same computer.

NOTE: please make sure that in case of receiving content over the network, the network bandwidth will allow you to view video without delays. PVQT do some bufferization before play, but it may not be enough.

Running projects
We recommend run tests using double-clicking project file (*.pvqt) in explorer (after installation of PVQT or PVQT player). You can install only PVQT Player to observers’ computers if you want to prevent accidentally editing of project. Also, you can protect project file for writing in file security settings.

IMPORTANT: regardless of whether the observers pass the test through a shared folder, or located on their computer, you must provide write access to the following directories (directories will be created automatically when you saves test. Or you can grant access to creating directories to observers’ users):

- <project full path>.archives
- <project full path>.protocols
- <project full path>.states

Methods of organization of testing

Single computer testing
All observers pass a test on the same computer. No additional preparations are needed. It can be the computer on which test was created, or project correctly transmitted to another computer.

We recommend install PVQT player (or full PVQT) to that computer and run test from Windows Explorer.

Testing via shared folder

In this method, the test can be run by an arbitrary number of observers simultaneously or not on computers on the same local network, for example, in a computer class. The test manager can view the results in real time.

Edit and save project to location available to another computers via shared folder. You should use “Relative paths” and all videos should be also available via same shared folder or be referred in project by network path.

Multiple observers can pass test simultaneously (for example, in computer class). If Editor for this project file is opened you can see progress and results of each observer in Real-time. Also, it will display overall progress in summary.

Testing with distributed observers

In this method, you are sending test and videos to observers, located anywhere, who will pass the test at any time. After test is complete, observers will send you back results of testing.

To use this method, specify email in field “Result collecting e-mail”. After test is finished, observer will be asked to send a special archive (*.pvqtres) file to that email.

After you collect some archives from observers, you can import them into PVQT using “Import results from *.pvqtres file” command (project should be saved). You can import multiple files at once.

Testing using mass view

This method will be implemented in the next versions of PVQT.

You choose to show the video on a large screen, for example, through a projector that is viewed by several observers. Each of them votes on their device.

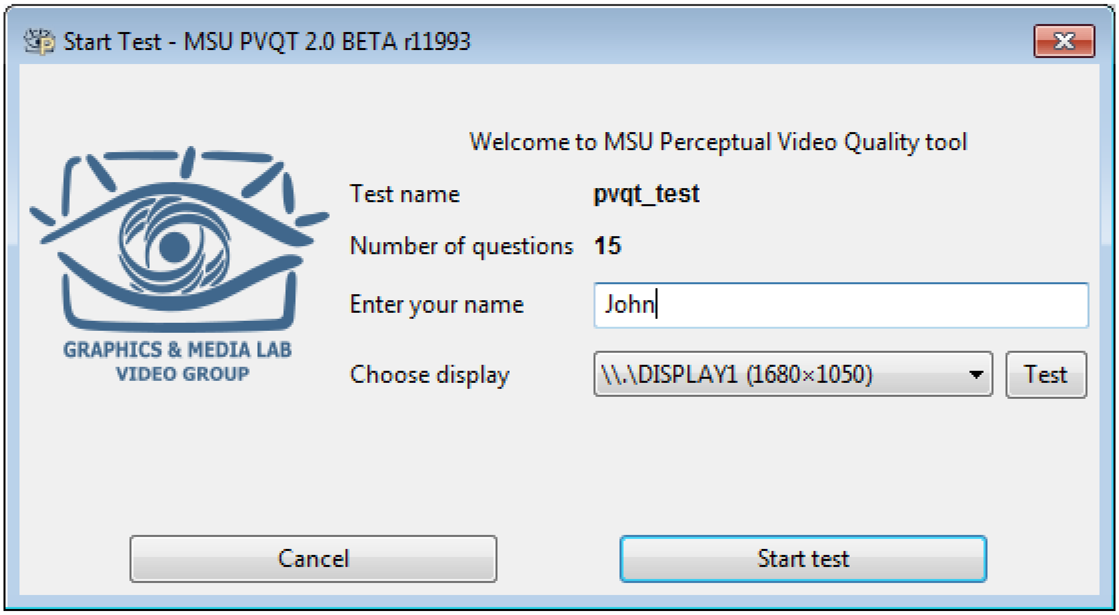
Passing a test

You can start test several ways:

- From Editor, using run command. NOTE: this will be discard existing progress if exists.
- Running Player and selecting project.
- Running project file from Windows explorer (recommended).

Starting a test

After test is started, observer is asked to enter name and select monitor. We recommend to test monitor using "Test" button before running test.



Start Test - MSU PVQT 2.0 BETA r11993

Welcome to MSU Perceptual Video Quality tool

Test name pvqt_test

Number of questions 15

Enter your name John

Choose display \\.\DISPLAY1 (1680×1050)

Player start window

At this stage, PVQT will check availability of all demanded videos. But it will not check correctness of videos. If some video became corrupted, the test will be interrupted when it reaches that video (the observer has the ability to try opening again before closing test).

Multi-monitor policy *PRO only feature*

If you selected another monitor, video playback and instructions will be shown on selected monitor. Instructions window assumes keyboard-only interaction.

Questions will be shown on that monitor, on which Start window will be closed. If you move question window to another monitor (another position), the next question will be displayed at that position.

You can move question window to video monitor if it is convenient and video monitor is suitable for question displaying and mouse interaction.

IMPORTANT: Tell to observer details of multi-monitor policy.

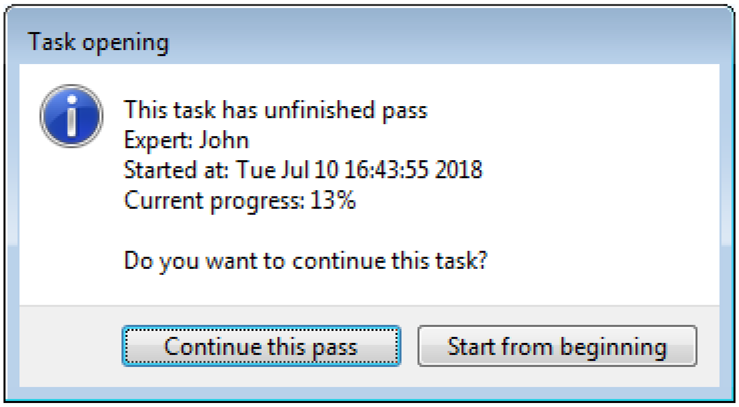
Interrupting & resuming test

Observer can resume test, interrupted at the same computer. The interruption could occur for the following reasons:

- Power outage,
- Software or hardware failure including PVQT internal error,
- Network problem, loss of sources availability,
- At the request of the observer.

In the last case, the observer is prompted to save or delete the state for later resuming.

When you run test, PVQT performs checking for unfinished states, and displays a suggestion to continue test with additional information:


Task opening

This task has unfinished pass
Expert: John
Started at: Tue Jul 10 16:43:55 2018
Current progress: 13%

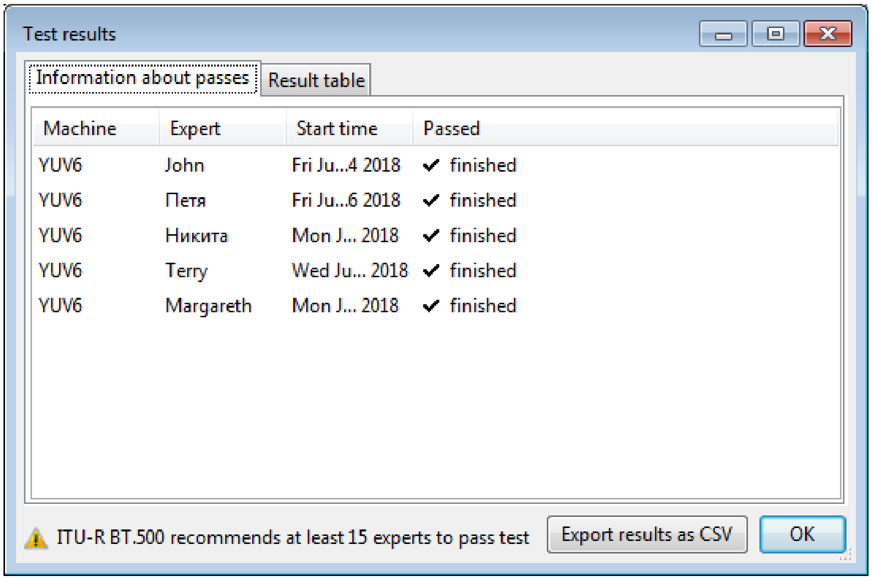
Do you want to continue this task?

Suggestion to continue a test

IMPORTANT: If you choose “Start from beginning”, the current unsaved progress will be deleted. You can’t store multiple not-finished passes for one computer.

Results inspection

In this section we suppose, you already collected or imported results into PVQT (in most cases, this is done automatically).



Machine	Expert	Start time	Passed
YUV6	John	Fri Ju...4 2018	✓ finished
YUV6	Петя	Fri Ju...6 2018	✓ finished
YUV6	Никита	Mon J... 2018	✓ finished
YUV6	Terry	Wed Ju... 2018	✓ finished
YUV6	Margareth	Mon J... 2018	✓ finished

⚠ ITU-R BT.500 recommends at least 15 experts to pass test

Results window look

Make sure that all the results you expect to see are presented in the “Information about passes” tab.

The tab “Result table” will display information only about finished passes.

NOTE: information in both tabs is updated in Real-time. If PVQT was unable to establish real-time monitor, you have a link-button “Refresh”, placed in statusbar.

The “Result table” tab contains all ranks of videos. In case of pair-comparison (like in SCACJ method), you will see only total result for each pair. In case or video-to-reference comparison, you will see rank given by each observer.

Also, the “Result table” tab contains averages and statistical characteristics:

- Mean rank,
- 95% confidence interval,
- Standard deviation.

For pair comparison, there available Bradley-terry ranks.

In feature releases, there will be available screening of observers, the elimination of the edge effect and more features.

Appendix: running PVQT from command line

PVQT has a few CMD-commands:

- <Player path> <project file> — run specified project
- <Editor path> edit <project file> — edit specified project
- <Editor path> play <project file> — run specified project by Editor
- <Editor path> -h — help about Editor command line