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**VCRACK OPERATION MANUAL
(FOR VERSION 10.03.2004 JPEG)**

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VCrack Operation Manual

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1. General description:

VCrack is designed for pavement surface distress data collection. It consists of a linescan CCD camera (Dalsa P2), a video frame grabber (Coreco Viper_CamLink), a control and processing unit (Industrial PC computer named VCrack computer through this document), and related software (VCrack module). In the TxDOT Vnet system, VCrack software is installed in the VCrack computer and is connected to the AppMgr computer through the on vehicle local network (VNet). VCrack real time data collection is controlled by AppMgr. However the offline operations including image processing, image grabbing require controls from VCrack computer interface.

2. User Interface on VCrack Module:

VCrack user interface provides useful information for both real time survey and offline image processing. These information are divided into three groups.

a). Network information:

Correct network connection is crucial for VCrack proper data collection. All survey operation and data reports are through the local network connection. Check these parameters each time before starting a survey.

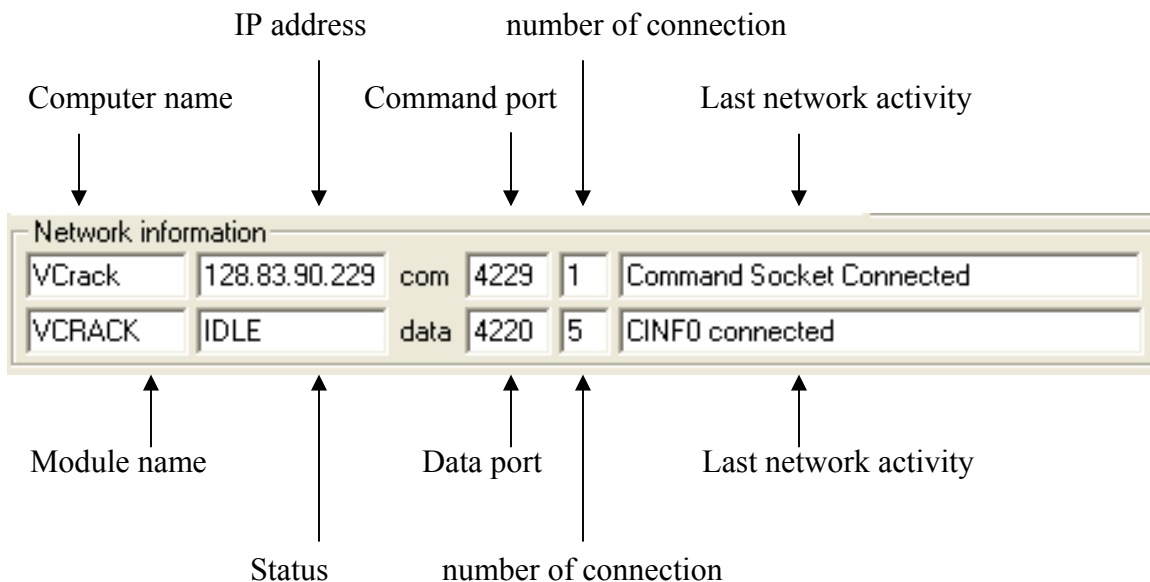


Figure 1. Network information

Computer name may vary from vehicle to vehicle. The IP address is dynamically assigned by the network controller in each vehicle. The module name, command port, and data port are defined in the PF99 protocol and should be same for all survey vehicles. There should be at least one command connection for the communication with AppMgr. The number of data connection depends on operation at the AppMgr. There are three possible statuses shown in the status box. REQ_REG means the network connection has not yet been properly established; IDLE means VCrack is ready for data communication; RUN indicates VCrack is running for real time data collection.

b). Survey information:

Survey information shows the real time status of VCrack module. These parameters are hardware related and should be checked before and during data collections.

Line Rate and Speed are related to the vehicle speed. Speed is displayed in miles per hour. Line Rate is a measure of camera scanning speed. It shows how many horizontal image lines grabbed per second.

F. Count and Scan No. stand for Frame Count and Scanned Number. VCrack has an image buffer in RAM, which holds 150 frames for the image acquisition. This buffer is looped over repeatedly during the data collection. Any time if operator stops the live image by click Video Freeze button, the last 150 grabbed images are kept in the buffer. These images can be saved to hard drive as an AVI file for later review. Scan No. shows how many images have been processed in a data report interval. In the current camera setup, there should be total 212 images in a 0.1 miles report interval. If any image is too dark, too bright, or fuzzy, the actual processed image will be less than 212. As an example, if the vehicle is not moving, there will be not image processing for distress data, therefore Scan No. will not change.

Suvery parameters					
Line Rate	Speed	F. Count:	Scan No.	Max expo	Exp time
2000	35	96	0	46.22673	45.22673

Figure 2. Survey information

Max expo and Exp time stand for Maximum exposure time and Exposure time in microsecond. The Exposure time is a control of camera/image brightness. The longer the exposure time is, the brighter the image appears. Max expo is an up limit of maximum brightness camera can achieve. It varies with current vehicle speed. At higher speed, there is only limited time assigned for each individual image. The relationship of Maximum exposure time and vehicle speed is given in the following table.

Vehicle Speed (mph)	Line Rate (scans/second)	Maximum Time (micro second)
5	1503	665.2
10	3007	332.6
15	4510	221.7
20	6013	166.3
25	7517	133.0
30	9020	110.9
35	10523	95.0
40	12026	83.2
45	13530	73.9
50	15033	66.5
55	16536	60.5
60	18040	55.4
65	19543	51.2
70	21046	47.5

Exp time is current exposure time for the camera. It is automatically adjusted when environment lighting and pavement surface conditions change. If Exp time is equal to the Max expo while images are still dark, the lighting condition is not sufficient for current survey speed. Please reduce the vehicle speed to increase Maximum time for the exposure, therefore the brightness of images.

3. Start VCrack

When the VCrack computer is powered up, VCrack should be start up automatically. A live image from the linescan camera should show. If the vehicle is not moving, the image shows a vertical pattern as in figure 3. Switch over to the VCrack computer (Roborater), if figure 3 screen has not yet shown, double click “VCrack.exe” icon to manually start VCrack.

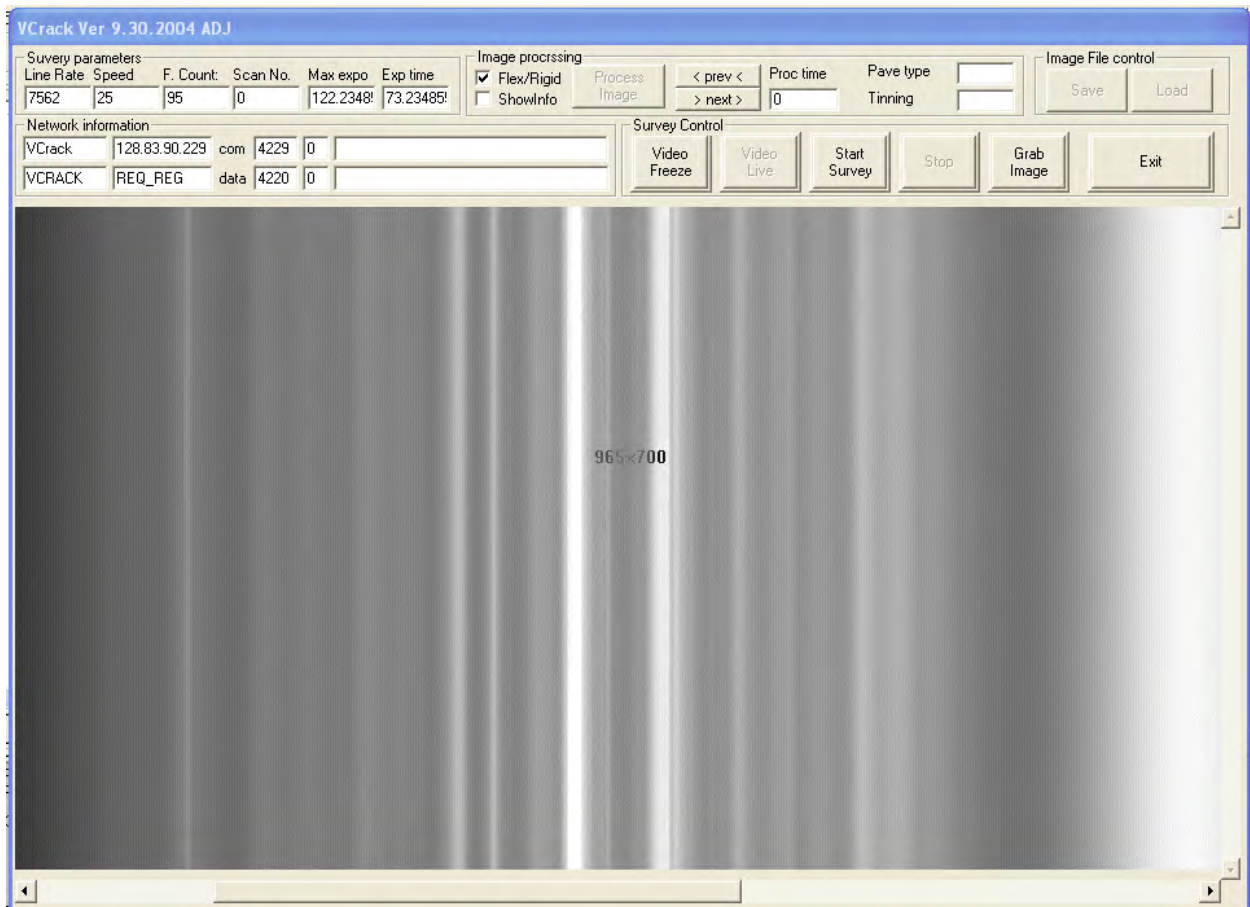


Figure 3. VCrack interface

4. Calibrating VCrack Camera

Camera calibration is crucial for imaging quality and scale. Figure 5 shows the camera lens used by VCrack. Make sure the iris ring at the smallest number (2.8 for current lens).

The actual width covered by VCrack camera depends on the height of the camera. Therefore each time after camera installation or adjustment, the height should be calibrated. Place two bright objects on ground in front of the survey vehicle as shown in figure 4. For the current setup, the distance between objects is 10 feet. Positions of these two objects should be sympatric to the center of camera. Check both end of the image by sliding the horizontal slide bar at the bottom of VCrack screen while move camera height slightly. As both objects' inner side edges are shown at corresponding ends of the image. The height of camera is right on scale.

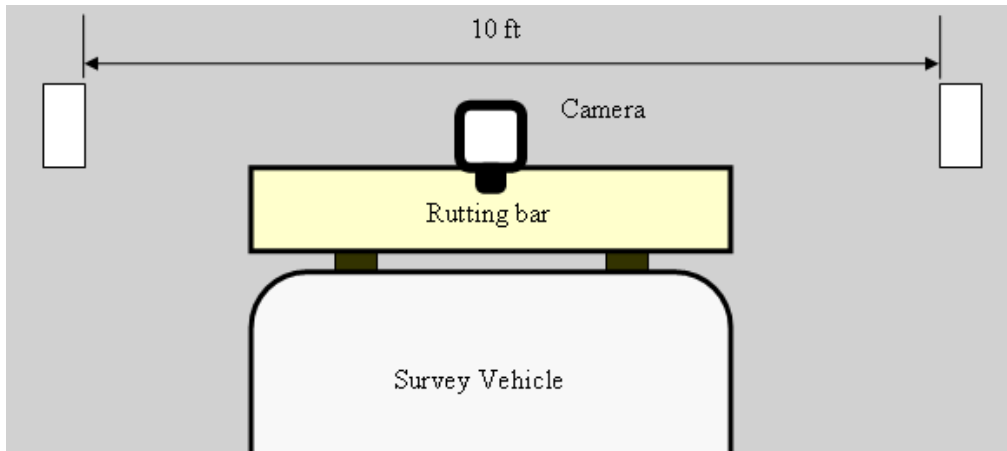


Figure 4. Camera Calibration

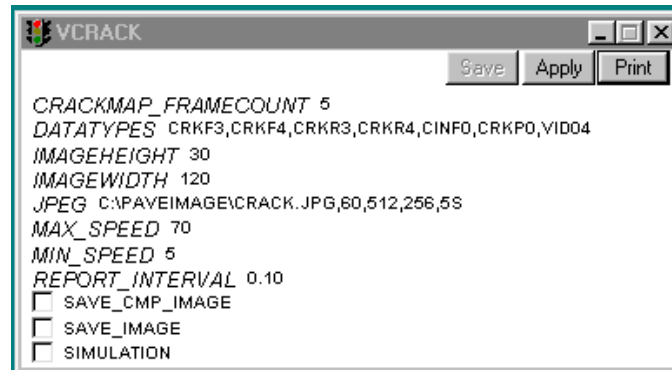
After calibration, camera focus needs to be adjusted before used for any image grabbing. Place the calibration board on ground right bellow the camera. Pull the focus ring to its top position (marked “-M-” for manual). Turn it count clockwise to the very end. Turn the ring backwards slowly while check the image quality. The best focal position should be between mark 3 and infinite. Push the ring down to “-AF” position to lock it after reaching the best focal position.



Figure 5. Camera Lens

5. Set Survey Parameters

VCrack parameters can be set from AppMgr through the local network connection. Double click the VCrack tag in the AppMgr window. A VCrack parameter window will pop up as shown bellow. Change a parameter to a proper value or selection then click “Apply”, the change/changes will be sent to VCrack module.



CRACKMAP_FRAMECOUNT controls the crack map data communication. VCrack will hold crack map data up to this number of frames, and then send them back. This number should be at least 5 to avoid excessive network activity.

IMAGEHEIHT represents the actual distance on pavement each image frame to cover. For the current VCrack version, please do not change this parameter.

IMAGEWIDTH indicates the width of pavement covered by the image frame. For the current VCrack version, please do not change this parameter.

JPEG is a multi parameter setup for remote image access. Operator has to follow exact order and format of each parameter to get proper images.

JPEG file_name,compression_ratio,pixel_width,pixel_heighth,update_interval

file_name should include full path, file name, and extension.

compression_ratio determines the size and quality of the image. Should be 5 to 99.

pixel_width: 128 to 2048.

pixel_height: 8 to 512.

update_interval controls how frequent the image should be updated. It can be either a time interval in 0.1 second increment or a distance gap in 0.1 mile increment. The format of this parameter is defined as a float number followed by a capital “S” for second or capital “MI” for miles. Sending a “0S” or “0MI” as the value of this parameter will stop the JPEG operation. While any nonzero value of this parameter will start or resume the JEPG image operation.

Examples:

JPEG C:\paveimage\crack.jpg,30,512,128,0.5S

Saves a 512x128, 30% compressed jpeg image to C:\paveimage\crack.jpg in every 0.5 second.

JPEG C:\paveimage\crack.jpg,20,1024,256,0.2MI

Saves a 1024x256, 20% compressed jpeg image to C:\paveimage\crack.jpg in every 0.2 miles.

SAVE_CMP_IMAGE is a control to save a continuous small pavement video (512x128 pixels) to C:\paveimage directory. The file name is automatically generated by VCrack on format of yyyyymmddhhmm_cmp.avi. The continuous video can cover up to five miles. If this control is selected, at the end of each data collection, the video will be saved to local hard disk automatically.

SAVE_IMAGE controls a full size image backup. If selected, VCrack will hold the last image on each report interval to a backup buffer. At the end of a data collection, the buffered images will be saved as an “avi” video to C:\paveimage\ with a file name of yyyyymmddhhmm_bkp.avi. The buffer can holds up to 20 miles continuous survey.

Beware these image operation will take times to process. Mostly it lost one to two frames of image while processing and save required image. It means reducing survey coverage at the real time data collection. Don't use these options unless it is necessary.

MAX_SPEED sets an up limit for the vehicle speed during data collection. Its value defined from 35 to 70 mph.

MIN_SPEED sets a bottom limit for the vehicle speed during data collection. Its value defined from 5 to 30 mph.

VCrack only runs within the speed range from MIN_SPEED to MAX_SPEED. If the actual vehicle speed is outside this range, either the image quality or the data quality will be affected.

REPORT_INTERVAL is a distance in which all survey data for individual frame will be accumulated to a single set of representation. At the end of each REPORT_INTERVAL this set of data will be sent back and recorded as a recorder.

SIMULATION is a control for offline training or simulation. Select this field and click “Apply”, VCrack will enter to simulation mode. Switch back to VCrack screen and select a proper pavement video file. VCrack will load this video file and perform simulation exactly the same as it runs a real time data collection. The video file should be a pre-saved full size pavement image video. Make sure the DMI broadcasting works well before start simulation. Uncheck SIMULATION will stop the simulation and put VCrack into normal data collection mode.

6. Offline operation

There is no need of any control at VCrack side for the real time data collection. However, for the image grabbing, offline image processing, and simulation, operator should switch to the VCrack screen for control and image maneuver. In this case, VCrack can be operated independently on its user interface.

Survey control:

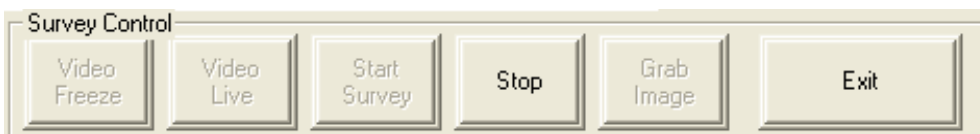
Survey control consists of five control buttons. These button are activated only when camera and frame grabber hardware working properly. Otherwise all five buttons will grey out as bellow.



The next screen shot shows a normal start of VCrack. The video is live and the F.Count number is rolling. But there is no image being processed for distress data. Now operator can stop video by click on "Video Freeze" for image processing, or saving the individual image or the entire image buffer to hard disk; "Grab Image" allows user to refill the 150 frame buffers and save them to hard disk; "Start Survey" is designed to start data collection from VCrack side instead of using "All Run" from AppMgr. VCrack will start processing image and collecting survey data itself. If there is any data connection to VCrack, it will send data to users with required format.



At "Run" mode, only the "Stop" control is activated. User can stop data collection at any time by click "Stop". VCrack then stops the data collection and keeps video live.



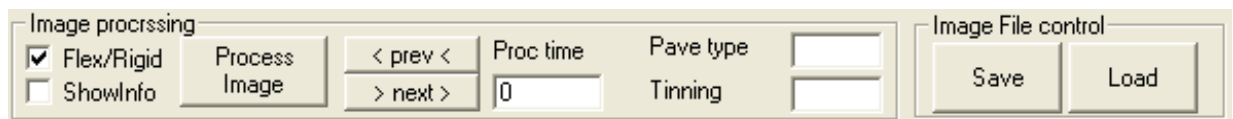
Click "Exit" button at any time will close VCrack.

Image processing

Image processing is an offline tools for image review and quality control. Please do not use it while data collection in process.

There are 150 images held within VCrack buffer. They are numbered from 0 to 149. These images are either grabbed from pavement or loaded from a disk file. Click “<prev<” for previous image or “>next>” for next image. Click “Process Image” button will have the current image processed. Distress data will be collected from this image. Processing time in millisecond is displayed in “Proc time” box. If the image is grabbed from flexible pavement, leave “Flex/Rigid” checked. Otherwise uncheck it for rigid pavement image. VCrack uses different algorithm for different type of pavement. During real time data collection, VCrack listens the pavement change command from AppMgr to choose right process for given pavement type.

“Pave type” box shows either “FLEX” or “RIGID” to confirm VCrack’s process in using. “Tinning” box shows tinning gap for rigid pavement.



7. Troubleshooting

VCrack module is pre-installed by a trained professional before handover to operator.