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CINE-GT 3403 Video Preservation 1
Assignment 1
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Dropout and Dropout Compensation

Imagine, in a fit of nostalgia you dig out your old VCR and box of VHS tapes from the dusty cabinet under the stairs. But while watching your old taped-from-the-TV copy of Buffy The Vampire Slayer Season 1, episodes one and two for the first time in years, little white dots and lines flash briefly on the screen. This appears momentarily. It would seem that there are some dropouts in the video. One thing is also certain, the dropout compensator in the VCR is not working (or not present) and, more importantly, you need to clean your deck!

Symptoms

Dropouts in a video signal most often appear as black, white and black-and-white dots with comet trails, but in more severe cases these may appear in entire lines across the image that flash black, white and black-and-white. These spots, or glitches, are called 'hits'.[1] They are typically under ten milliseconds in duration and may sometimes occur at a few second intervals. The colour usually depends on the circuit arrangements used to recover the video information.[2] The reason they are so obvious in a display is the largely due to the difference in their luminance and the mean luminance of the surrounding area.[3] When the hits occur in evenly lit, low contrast

[1] Richard Robinson, *The Video Primer*, 3rd Edition (New York: Perigee Books, The Putnam Publishing Group, 1983), 100.
[2] W.K.E. Geddes, "R&D Report 1964-77 : Simple drop-out compensator for video tape recorders," Technological Report 1964-77 (The British Broadcasting Corporation Engineering Division, Jan 1964), 1.
[3] Geddes, "R&D Report 1964-77 : Simple drop-out compensator for video tape recorders," 2.

scene, they will be much more noticeable than ones occurring in busy, colorful or high contrast scenes. Ken Marsh likens the difference between the two to a match struck in bright daylight (a colorful, busy scene) and a match struck in a dark tunnel (a low contrast scene).[4] Where audio is concerned, the volume of audio recorded in the longitudinal track may be somewhat affected, but FM or PCM audio recorded in the helical tracks will be more affected by dropouts. This may produce snapping, crackling or become briefly inaudible.[5]

Though they may look similar, dropouts should not be confused with the head switching points, which happen when the player switches from one video head to the other, as they alternate reading helical tracks. Sometimes these will be apparent in the active video image due to maladjustment in the deck. The head switching points appear at the bottom of the image and flash continuously. Unlike dropouts, the head switching points always appear in the same scan line while moving slightly from side to side.[6]

After a video is transferred, it is possible to use QC Tools to identify and analyze video dropout.[7] The filter used is called TOUT, which stands for Temporal Outliers. It was created to detect speckle noise by comparing pixels to the ones above and below them, calculating an average, and showing any dramatic difference in the value.[8]

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[4] Ken Marsh, *Independent Video: A Complete Guide to the Physics, Operation, and Application of the New Television for the Student, The Artist, and for Community TV* (San Francisco: Straight Arrow Books, 1974), 126.
[5] Johannes Gfeller, Agathe Jarczyk and Johanna Phillips, *Compendium of Image Errors in Analogue Video* (Switzerland: SIK ISEA, 2012), 90.
[6] Gfeller, Jarczyk and Phillips, *Compendium of Image Errors in Analogue Video,* 90.
[7] "Video Dropout," A/V Artifact Atlas, last modified December 6th, 2017, https://bavc.github.io/avaa/artifacts/video_dropout.html.
[8] "Temporal Outliers (TOUT)," Media Area, accessed October 12th, 2018, https://mediaarea.net/QCTools/Filter_Descriptions#tout.

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Causes

Dropouts are caused by momentary loss of signal due to a brief interruption in the contact between head and tape or damage to the magnetic layer on the tape.[9] The video head is not able to read the information and the RF is interrupted. This may happen because of spots of oxide missing from the binder[10] or dust particles and debris interfere in the playback heads reading of the tape. Often this is also caused by physical damage to the magnetic layer itself. The tape may be scratched or worn, or a manufacturing defect can cause the magnetic layer to be faulty or contain holes due to tiny bubbles in the emulsion used for the binder.[11]

Dropout can also be recorded into the original content, meaning that the issue was present in an earlier generation of the recording and was permanently recorded on the tape. This can be confirmed by "stepping through" the video frame by frame to reveal the recorded-in dropouts.

Cures: Dropout Compensation

Automated dropout compensators can be found in most video players, and are located in the playback section of the machine.[12] These most commonly split the video signal into two distinct paths, one that is direct and one that is delayed by exactly one line. If dropout is detected, the delayed, intact signal of the preceding scan line from the other path is used to fill in the gap created by the dropout. This same content is repeated for as long as the dropout lasts, which can

[9] Gfeller, Jarczyk and Phillips, *Compendium of Image Errors in Analogue Video*, 62.
[10] Robinson, *The Video Primer*, 100.
[11] Gfeller, Jarczyk and Phillips, *Compendium of Image Errors in Analogue Video*, 62.
[12] Marsh, *Independent Video: A Complete Guide to the Physics, Operation, and Application of the New Television for the Student, The Artist, and for Community TV*, 126.

be multiple scan lines.[13] [14] A similar method of dropout compensation is used exclusively in VTRs for ½ inch video, according to Ken Marsh's writing on the subject. This compensator uses a multiple line delay and switch method. The dropouts are detected in both methods by monitoring the RF signal, when the signal is below a set point, or there is a drop, a switch is triggered.[15]

Another method of using QC Tools to detect dropout in digitized video employs the Vertical Line Repetitions graph. This filter notes repetitions caused by the compensator. It compares a given video line to another video line that occured 4 pixels earlier. If the difference between the two compared lines is less than 512, the filter reads them as identical enough to appear as a repetition. [16]

Another method of compensating uses a crystal which emits a steady signal. When a dropout occurs, the signal from the crystal is inserted rather than that from the previous line. This signal is set at a level which represents black, gray or white.[17] This type of compensator cannot restore the shape of a synchronizing pulse that has been marred by a drop-out, unlike the line-delay version.[18]

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[13] Gfeller, Jarczyk and Phillips, *Compendium of Image Errors in Analogue Video*, 62.
[14] Of potential interest, here is frequency demodulator and dropout compensator found online for sale: http://dsmcz.com/prestashop/analogue/1938-tda3730-frequency-demodulator-and-drop-out-compensator-for-video-recoders.html
[15] Marsh, I*ndependent Video: A Complete Guide to the Physics, Operation, and Application of the New Television for the Student, The Artist, and for Community TV*, 126.
[16] "Vertical Line Repetitions (VREP)," Media Area, accessed October 12th, 2018, https://mediaarea.net/QCTools/Filter_Descriptions#vrep
[17] Marsh, I*ndependent Video: A Complete Guide to the Physics, Operation, and Application of the New Television for the Student, The Artist, and for Community TV*, 126.
[18] For a more nuanced and detailed description of the mechanics involved in this type of compensator, see Geddes, "R&D Report 1964-77 : Simple drop-out compensator for video tape recorders," 2 - 3.
For more detailed descriptions of various dropout compensatorsand harware including dropout compensators, see patents US3573359A

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Preservation Concerns to Conclude

In terms of the preservation of video material, a few concerns must be addressed when it comes to dropout and dropout compensation. It is essential when transferring tape to digital for preservation purposes, to clean all hardware thoroughly before using it with any archival material, to prevent signal loss and dropouts. The entire tape path, every part of the hardware that the tape touches, must be cleaned. The heads can be cleaned with isopropyl alcohol, but any rubber parts should be cleaned without alcohol, since it may dry up the material.

There is an important ethical element regarding the transfer of video which contains dropouts. If dropout is recorded in, this is a part of the essence being captured and should be recorded in the preservation file as such. If dropouts occur during the transfer, this is a fault in the preservation process itself, which is less than ideal to say the least. However, using a compensator to insert the previous line or an alternate signal from a crystal presents the issue of adding to the essence being captured for preservation. This issue could be the subject of a much longer paper examining the issue of altering material in a preservation setting, which will not be covered here beyond raising the issue.

(https://patents.google.com/patent/US3573359A/en?q=dropout&q=compensation&oq=dropout+compensation), US2996576A (https://patents.google.com/patent/US2996576A/en?q=dropout&q=compensation&oq=dropout+compensation), US4492988A (https://patents.google.com/patent/US4492988A/en), US4509078 (http://www.freepatentsonline.com/4509078.pdf) and US4492988 (https://patentimages.storage.googleapis.com/18/cd/26/568e404226e574/US4492988.pdf).

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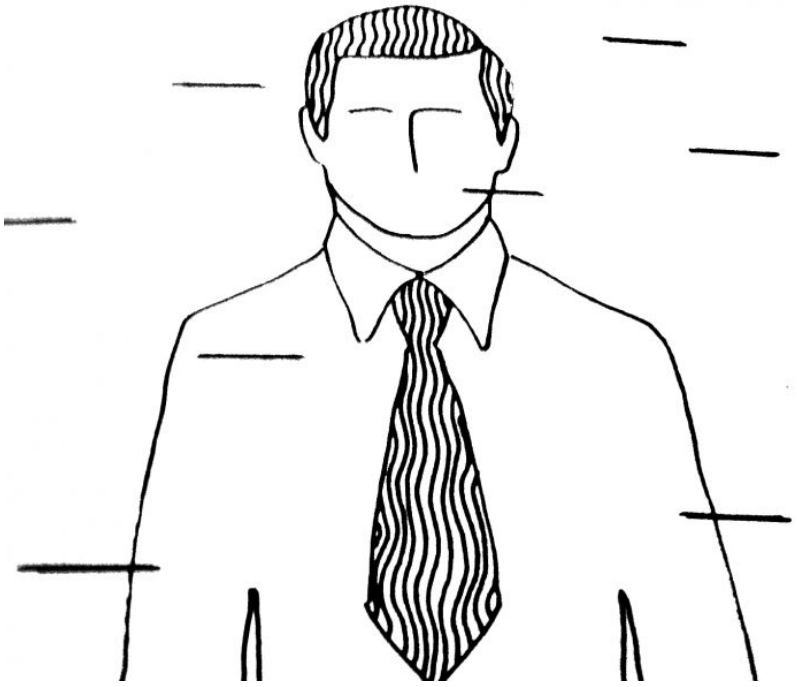
Appendix: Images

Dropout in Video Image
Source: Johannes Gfeller, Agathe Jarczyk and Johanna Phillips, *Compendium of Image Errors in Analogue Video* (Switzerland: SIK ISEA, 2012), 63.



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Dropout in Video Image Explanatory Drawing
Source: “Video Dropout,” A/V Artifact Atlaslast modified December 6th, 2017, https://bavc.github.io/avaa/artifacts/video_dropout.html.

Head Switching (not to be confused with dropout as discussed in this paper)
Souce: Johannes Gfeller, Agathe Jarczyk and Johanna Phillips, *Compendium of Image Errors in Analogue Video* (Switzerland: SIK ISEA, 2012), 90.

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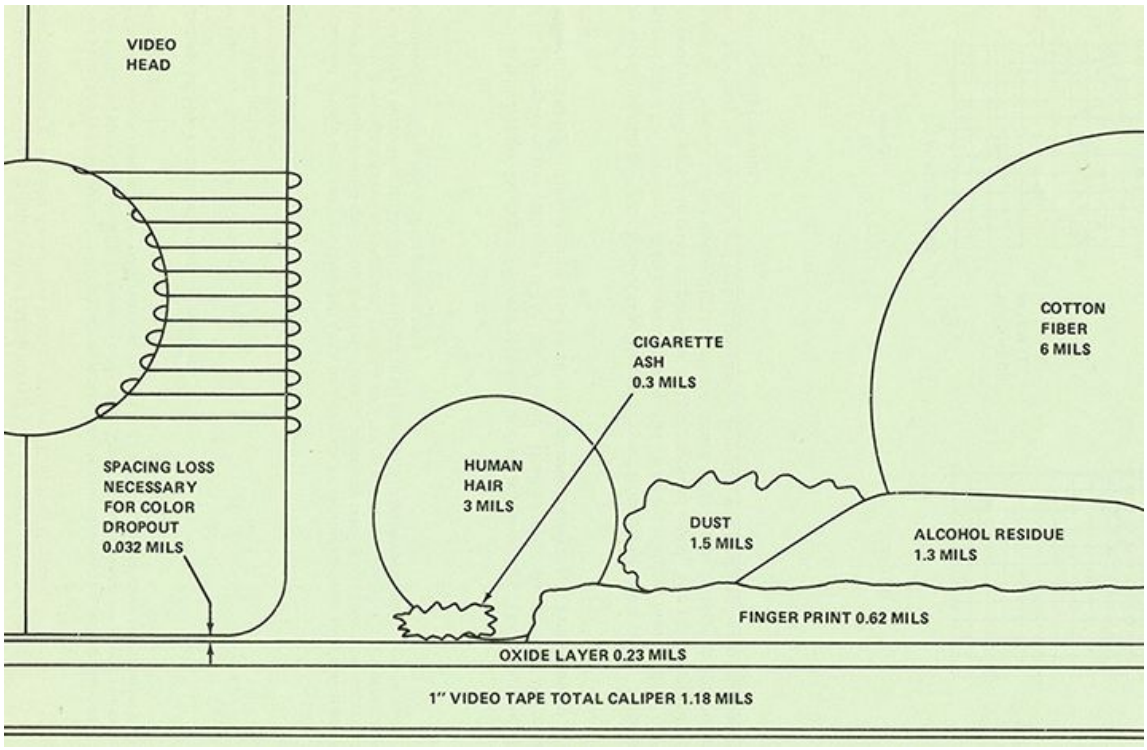

3M's Debris Perspective on 1" Tape, early 1970s
Source: "Video Dropout," A/V Artifact Atlas, last modified December 6th, 2017, https://bavc.github.io/avaa/artifacts/video_dropout.html.

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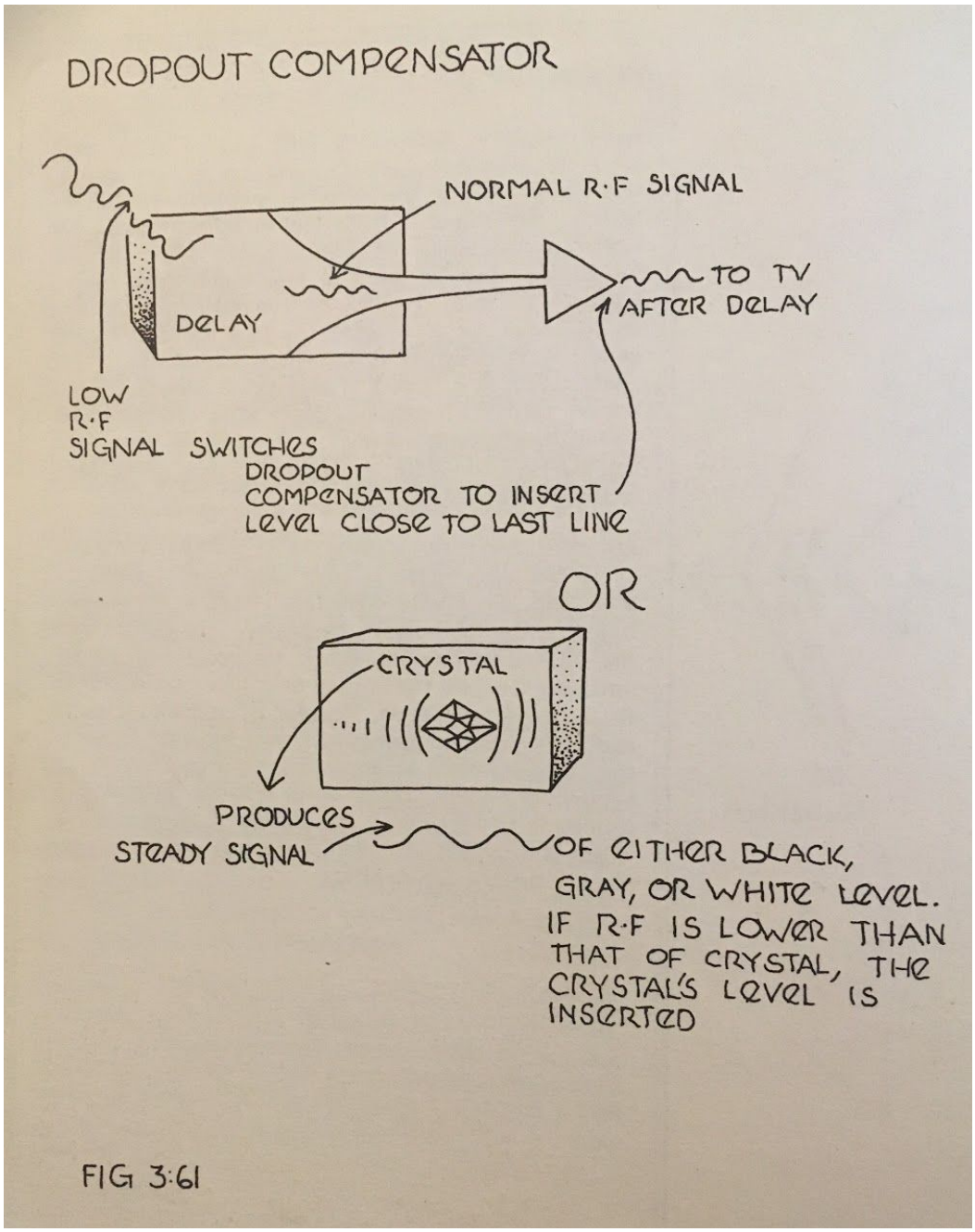

Dropout Compensator Explanatory Illustration
Source: Ken Marsh, Independent Video: A Complete Guide to the Physics, Operation, and Application of the New Television for the Student, The Artist, and for Community TV (San Francisco: Straight Arrow Books, 1974), 126.

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Appendix: Definitions from *Compendium of Image Errors in Analogue Video*

Dropout: " The symptom is a black, white or black-and-white dot that flashes briefly on-screen and may have a horizontal comet tail. A severe dropout may disrupt one or more scan lines so that they flash black and white along their entire length.
>*Dropouts and Dropout Compensation* occur when the video or audio signal is briefly interrupted, e.g. due to dirt particles on the tape or damage to the magnetic layer.

Dropout Compensator: "A circuit built into video players and recorders that is capable of mitigating the majority of dropouts by replacing the noisy areas ina scan line with intact content from preceding lines. The dropout compensator does this by splitting the video signal into one direct path, and one path that delays the signal by exactly one line. The compensator detects signal dropout as soon as it happens, and immediately switches over to the delayed, intact substitute signal from the preceding line. Content from the intact line is repeated for as long as the dropout lasts, over multiple lines if necessary. Multi-line repetition will, of course, be clearly visible to viewers."

Souce: Johannes Gfeller, Agathe Jarczyk and Johanna Phillips, Compendium of Image Errors in Analogue Video (Switzerland: SIK ISEA, 2012), 215-216.