



1
00:00:04,150 --> 00:00:01,990
this video is a response to a discussion

2
00:00:06,789 --> 00:00:04,160
between former fighter pilot chris lato

3
00:00:07,990 --> 00:00:06,799
and thermal camera technician dave fulch

4
00:00:10,310 --> 00:00:08,000
in that discussion

5
00:00:12,070 --> 00:00:10,320
dave claimed to debunk my rotating glare

6
00:00:14,230 --> 00:00:12,080
hypothesis for the gimbal video and

7
00:00:15,829 --> 00:00:14,240
chris claims to understand this

8
00:00:17,349 --> 00:00:15,839
i'll demonstrate that neither claim is

9
00:00:19,269 --> 00:00:17,359
true

10
00:00:21,029 --> 00:00:19,279
but first let's start by establishing

11
00:00:23,509 --> 00:00:21,039
some facts

12
00:00:25,509 --> 00:00:23,519
firstly this is an example of infrared

13
00:00:27,750 --> 00:00:25,519

glare that obscures an entire plane

14

00:00:29,589 --> 00:00:27,760

it's from the chilean navy ufo case that

15

00:00:34,150 --> 00:00:29,599

was solved in 2017.

16

00:00:36,470 --> 00:00:34,160

it's an airbus a340 iberia flight 6830

17

00:00:37,430 --> 00:00:36,480

in infrared we see only large glares

18

00:00:39,670 --> 00:00:37,440

around the engine

19

00:00:41,830 --> 00:00:39,680

and we can't see the plane so infrared

20

00:00:44,470 --> 00:00:41,840

glare exists

21

00:00:46,310 --> 00:00:44,480

secondly this is a narrow field of view

22

00:00:48,630 --> 00:00:46,320

a thousand millimeter focal length the

23

00:00:50,470 --> 00:00:48,640

plane is over 60 miles away so infrared

24

00:00:52,470 --> 00:00:50,480

layer that obscures an airplane exists

25

00:00:54,709 --> 00:00:52,480

in narrow field of view

26

00:00:55,830 --> 00:00:54,719

thirdly the shape of a glare is relative

27

00:00:57,750 --> 00:00:55,840

to the camera

28

00:00:59,830 --> 00:00:57,760

so if you rotate the camera the scene

29

00:01:01,990 --> 00:00:59,840

rotates but the glare will stay in the

30

00:01:03,430 --> 00:01:02,000

same orientation in the video

31

00:01:05,270 --> 00:01:03,440

you can demonstrate this with a phone

32

00:01:07,030 --> 00:01:05,280

pointing at a flashlight rotate the

33

00:01:09,670 --> 00:01:07,040

phone and in the video the background

34

00:01:12,390 --> 00:01:09,680

rotates but the glare does not

35

00:01:15,030 --> 00:01:12,400

fourthly a derotation mechanism will

36

00:01:16,230 --> 00:01:15,040

rotate the entire image glare and all

37

00:01:17,749 --> 00:01:16,240

and will have no effect on the

38

00:01:19,109 --> 00:01:17,759

orientation of the glare within the

39

00:01:21,749 --> 00:01:19,119

scene

40

00:01:23,590 --> 00:01:21,759

what does that mean well the aptly a

41

00:01:25,190 --> 00:01:23,600

camera system is mounted inside a pod

42

00:01:25,749 --> 00:01:25,200

that must rotate to keep tracking an

43

00:01:27,590 --> 00:01:25,759

object

44

00:01:29,670 --> 00:01:27,600

but the pilot does not want the image on

45

00:01:30,310 --> 00:01:29,680

screen rotating they want the horizon on

46

00:01:32,390 --> 00:01:30,320

their screen

47

00:01:34,469 --> 00:01:32,400

to match the horizon through the window

48

00:01:35,429 --> 00:01:34,479

so there's a d rotation mechanism built

49

00:01:37,510 --> 00:01:35,439

in to correct that

50

00:01:40,789 --> 00:01:37,520

it simply rotates the entire image back

51
00:01:43,830 --> 00:01:40,799
so the horizon is in the right place

52
00:01:45,670 --> 00:01:43,840
finally if you derotate an image in

53
00:01:47,030 --> 00:01:45,680
which the background has rotated but the

54
00:01:48,469 --> 00:01:47,040
glare has not rotated

55
00:01:50,550 --> 00:01:48,479
then it's going to look like the glare

56
00:01:52,069 --> 00:01:50,560
rotates but the background doesn't

57
00:01:53,670 --> 00:01:52,079
we can demonstrate that by using the

58
00:01:56,230 --> 00:01:53,680
same video from earlier

59
00:01:57,749 --> 00:01:56,240
the simplest way to de-rotate it is just

60
00:01:59,670 --> 00:01:57,759
to film it with another camera

61
00:02:01,749 --> 00:01:59,680
now the image remains stable but the

62
00:02:04,870 --> 00:02:01,759
glare seems to rotate

63
00:02:06,950 --> 00:02:04,880

to recap infrared glare exists it can

64

00:02:08,150 --> 00:02:06,960

cover a plane it exists even in narrow

65

00:02:10,229 --> 00:02:08,160

field of view

66

00:02:12,070 --> 00:02:10,239

glare shape is relative to the camera

67

00:02:13,110 --> 00:02:12,080

rotating the camera rotates the scene

68

00:02:14,710 --> 00:02:13,120

but not the glare

69

00:02:17,750 --> 00:02:14,720

so the angle of the glare relative to

70

00:02:20,869 --> 00:02:17,760

the scene changes derotating the image

71

00:02:22,550 --> 00:02:20,879

rotates everything the same amount

72

00:02:24,390 --> 00:02:22,560

derotating an image where the background

73

00:02:26,150 --> 00:02:24,400

has rotated but the glare has not will

74

00:02:30,150 --> 00:02:26,160

make it look like the background has not

75

00:02:33,030 --> 00:02:30,160

rotated but the glare has rotated

76
00:02:33,670 --> 00:02:33,040
okay now let's get into dave's debunking

77
00:02:35,270 --> 00:02:33,680
first of all

78
00:02:38,630 --> 00:02:35,280
dave agrees with me about the function

79
00:02:42,070 --> 00:02:38,640
of the derotation mechanism

80
00:02:44,790 --> 00:02:42,080
why do you need that i guess like

81
00:02:45,910 --> 00:02:44,800
let's say you have your gimbal when it's

82
00:02:47,589 --> 00:02:45,920
rotating

83
00:02:49,190 --> 00:02:47,599
you don't want the scene to rotate to

84
00:02:51,990 --> 00:02:49,200
the side so you have a d

85
00:02:53,990 --> 00:02:52,000
rotation counteract that it's going to

86
00:02:55,670 --> 00:02:54,000
rotate the whole scene

87
00:02:57,910 --> 00:02:55,680
okay so we're all in agreement the

88
00:02:58,390 --> 00:02:57,920

derotation mechanism rotates the entire

89

00:02:59,830 --> 00:02:58,400

scene

90

00:03:02,309 --> 00:02:59,840

and it's there to keep the horizon in

91

00:03:03,670 --> 00:03:02,319

the right place so let's see dave's

92

00:03:06,149 --> 00:03:03,680

objection

93

00:03:07,110 --> 00:03:06,159

the big thing is refraction versus

94

00:03:09,830 --> 00:03:07,120

reflection

95

00:03:10,309 --> 00:03:09,840

because he likes talking about how the

96

00:03:15,030 --> 00:03:10,319

glare

97

00:03:16,309 --> 00:03:15,040

about it's um

98

00:03:18,070 --> 00:03:16,319

it's something to do where there's

99

00:03:20,790 --> 00:03:18,080

already an existing glare

100

00:03:21,430 --> 00:03:20,800

and then he theorizes that the gimbal

101
00:03:23,270 --> 00:03:21,440
moves

102
00:03:25,509 --> 00:03:23,280
and then like a derotation device

103
00:03:28,149 --> 00:03:25,519
counteracts the rotation

104
00:03:28,630 --> 00:03:28,159
of the gimbal moving but what i'm saying

105
00:03:34,710 --> 00:03:28,640
is

106
00:03:35,910 --> 00:03:34,720
it's going to rotate the whole scene

107
00:03:38,869 --> 00:03:35,920
opposed to

108
00:03:39,910 --> 00:03:38,879
refracting if you have a lens like this

109
00:03:43,190 --> 00:03:39,920
this is like a

110
00:03:44,869 --> 00:03:43,200
silicone then you might have some

111
00:03:47,350 --> 00:03:44,879
refraction with the glare

112
00:03:49,670 --> 00:03:47,360
you have the lens moving but the d

113
00:03:51,990 --> 00:03:49,680

rotation device that he touches on

114

00:03:53,110 --> 00:03:52,000

it's it's not that at all it's it's a

115

00:03:55,830 --> 00:03:53,120

couple mirrors

116

00:03:56,789 --> 00:03:55,840

like this that are going to rotate the

117

00:03:59,350 --> 00:03:56,799

whole scene

118

00:04:00,390 --> 00:03:59,360

so the object can't independently rotate

119

00:04:02,190 --> 00:04:00,400

on its own

120

00:04:03,910 --> 00:04:02,200

magically like this glare that he's

121

00:04:06,710 --> 00:04:03,920

hypothesizing with

122

00:04:08,550 --> 00:04:06,720

follow that he says the derotation

123

00:04:09,830 --> 00:04:08,560

device rotates the whole scene which is

124

00:04:11,750 --> 00:04:09,840

what i say

125

00:04:13,270 --> 00:04:11,760

then he says as opposed to refracting

126
00:04:14,949 --> 00:04:13,280
which doesn't really make any sense but

127
00:04:16,550 --> 00:04:14,959
it's also irrelevant as it just agreed

128
00:04:17,909 --> 00:04:16,560
with me that the de-rotation mechanism

129
00:04:20,469 --> 00:04:17,919
rotates the entire scene

130
00:04:22,310 --> 00:04:20,479
including the glare by the same amount

131
00:04:24,870 --> 00:04:22,320
remember what we established earlier

132
00:04:27,350 --> 00:04:24,880
glare shape is relative to the camera if

133
00:04:29,909 --> 00:04:27,360
the camera rotates the scene will rotate

134
00:04:31,030 --> 00:04:29,919
but the glare will not derotating the

135
00:04:32,710 --> 00:04:31,040
entire image

136
00:04:36,070 --> 00:04:32,720
makes it look like the scene is not

137
00:04:39,110 --> 00:04:36,080
rotating but the glare is rotating

138
00:04:41,430 --> 00:04:39,120

how does chris respond to this

139

00:04:43,510 --> 00:04:41,440

so the way i understand it is that it's

140

00:04:44,550 --> 00:04:43,520

coming in and so there's a glare somehow

141

00:04:48,550 --> 00:04:44,560

on the lens

142

00:04:50,790 --> 00:04:48,560

that but it's not it it rotates

143

00:04:51,909 --> 00:04:50,800

right and so the actual scent the image

144

00:04:53,670 --> 00:04:51,919

is is the same

145

00:04:56,070 --> 00:04:53,680

right it's seeing the image but since

146

00:04:58,150 --> 00:04:56,080

the glass is rotating on top of it

147

00:04:59,909 --> 00:04:58,160

that changes just the glare but not

148

00:05:02,070 --> 00:04:59,919

really all the other image which is seen

149

00:05:03,990 --> 00:05:02,080

normally that's the way i understand it

150

00:05:05,510 --> 00:05:04,000

well kind of glare isn't something

151
00:05:07,510 --> 00:05:05,520
that's on the lens

152
00:05:09,670 --> 00:05:07,520
glare is a scattering of light or

153
00:05:10,469 --> 00:05:09,680
radiation around a very bright radiation

154
00:05:12,469 --> 00:05:10,479
source

155
00:05:14,390 --> 00:05:12,479
a lens window or mirror has

156
00:05:15,990 --> 00:05:14,400
imperfections so a small portion of the

157
00:05:17,110 --> 00:05:16,000
light gets scattered

158
00:05:18,870 --> 00:05:17,120
the amount and direction of this

159
00:05:20,710 --> 00:05:18,880
scattering is defined by the glare

160
00:05:22,310 --> 00:05:20,720
spread function which is also called the

161
00:05:23,670 --> 00:05:22,320
point spread function

162
00:05:25,670 --> 00:05:23,680
but i think what he's trying to convey

163
00:05:27,430 --> 00:05:25,680

here is that the glare has already

164

00:05:29,830 --> 00:05:27,440

rotated relative to the horizon because

165

00:05:32,550 --> 00:05:29,840

the camera has rotated

166

00:05:33,350 --> 00:05:32,560

dave's response to this is interesting

167

00:05:35,350 --> 00:05:33,360

okay

168

00:05:36,629 --> 00:05:35,360

we'll touch on that um there's going to

169

00:05:38,710 --> 00:05:36,639

be two different

170

00:05:39,670 --> 00:05:38,720

sensors there's going to be a daylight

171

00:05:41,749 --> 00:05:39,680

camera sensor

172

00:05:43,510 --> 00:05:41,759

which is going to utilize the sapphire

173

00:05:44,710 --> 00:05:43,520

glass then there's going to be the

174

00:05:46,390 --> 00:05:44,720

infrared sensor

175

00:05:48,550 --> 00:05:46,400

that's it's going to have this kind of

176

00:05:51,749 --> 00:05:48,560

acid germanium or silicone or

177

00:05:53,110 --> 00:05:51,759

some other type of semiconductor

178

00:05:55,830 --> 00:05:53,120

metalloid

179

00:05:58,309 --> 00:05:55,840

so what what they're doing there is heat

180

00:06:01,189 --> 00:05:58,319

doesn't travel through just glass

181

00:06:02,629 --> 00:06:01,199

sapphire glass it actually blocks it so

182

00:06:04,230 --> 00:06:02,639

if you're trying to run from the cops

183

00:06:05,350 --> 00:06:04,240

one of your best places to hide is

184

00:06:07,029 --> 00:06:05,360

probably a greenhouse

185

00:06:09,270 --> 00:06:07,039

just nothing but glass sounds legit

186

00:06:11,670 --> 00:06:09,280

right as dave is the ir expert right

187

00:06:13,430 --> 00:06:11,680

wrong the lockheed martin sniper

188

00:06:14,390 --> 00:06:13,440

targeting pot that chris is probably

189

00:06:16,790 --> 00:06:14,400

familiar with

190

00:06:18,550 --> 00:06:16,800

actually uses a sapphire glass window

191

00:06:20,309 --> 00:06:18,560

specifically because sapphire glass is

192

00:06:23,029 --> 00:06:20,319

transparent to both visible light

193

00:06:24,230 --> 00:06:23,039

and medium wave infrared the lantern and

194

00:06:26,150 --> 00:06:24,240

at-flare parts use

195

00:06:27,830 --> 00:06:26,160

zinc sulfide which is similar to

196

00:06:29,189 --> 00:06:27,840

germanium in that it's transparent to

197

00:06:31,350 --> 00:06:29,199

the long wave infrared

198

00:06:33,670 --> 00:06:31,360

however it's also transparent to visible

199

00:06:35,189 --> 00:06:33,680

light germanium is opaque

200

00:06:37,430 --> 00:06:35,199

so that dave's misunderstanding

201
00:06:38,950 --> 00:06:37,440
something fairly significant

202
00:06:41,110 --> 00:06:38,960
so dave's objection doesn't really make

203
00:06:42,790 --> 00:06:41,120
any sense until his credit chris later

204
00:06:45,189 --> 00:06:42,800
admits he didn't really understand what

205
00:06:47,029 --> 00:06:45,199
dave is saying and asked him to clarify

206
00:06:48,309 --> 00:06:47,039
i understand that argument actually can

207
00:06:50,950 --> 00:06:48,319
you go through that again

208
00:06:53,350 --> 00:06:50,960
please so the d rotation device is

209
00:06:54,950 --> 00:06:53,360
something similar to this you can see

210
00:06:58,070 --> 00:06:54,960
when i turn it it rotates the whole

211
00:07:00,309 --> 00:06:58,080
scene it ro it rotates

212
00:07:03,510 --> 00:07:00,319
opposite the sensor so that the sensor

213
00:07:05,270 --> 00:07:03,520

always sees the correct up and down

214

00:07:06,629 --> 00:07:05,280

is that what you're saying sure and

215

00:07:08,870 --> 00:07:06,639

that's what his big

216

00:07:10,710 --> 00:07:08,880

argument was at first until i showed him

217

00:07:14,950 --> 00:07:10,720

on with it using his own

218

00:07:15,510 --> 00:07:14,960

um example um the atlar pdf i think he

219

00:07:18,309 --> 00:07:15,520

found

220

00:07:20,070 --> 00:07:18,319

online somewhere that should like um

221

00:07:21,029 --> 00:07:20,080

what the internals were like internal

222

00:07:22,790 --> 00:07:21,039

schematics

223

00:07:24,150 --> 00:07:22,800

and i said well that derotation device

224

00:07:26,230 --> 00:07:24,160

it explains that it's

225

00:07:27,430 --> 00:07:26,240

it's a mirror it's an infrared mirror

226

00:07:28,070 --> 00:07:27,440

which you're not going to have on

227

00:07:31,189 --> 00:07:28,080

anything

228

00:07:31,670 --> 00:07:31,199

like this these are all internal optics

229

00:07:34,790 --> 00:07:31,680

of

230

00:07:36,550 --> 00:07:34,800

app floor or fliers that um

231

00:07:38,230 --> 00:07:36,560

yeah you're not gonna have any exposure

232

00:07:40,870 --> 00:07:38,240

to them unless you're somebody

233

00:07:42,469 --> 00:07:40,880

like myself or john that makes any sense

234

00:07:44,070 --> 00:07:42,479

notice he doesn't really make any points

235

00:07:45,909 --> 00:07:44,080

here and then ends it with an argument

236

00:07:47,430 --> 00:07:45,919

to authority the john he refers to is

237

00:07:48,950 --> 00:07:47,440

john earhart who had a similar

238

00:07:50,469 --> 00:07:48,960

misunderstanding that i covered in

239

00:07:52,390 --> 00:07:50,479

another video

240

00:07:54,070 --> 00:07:52,400

chris recognizes both this appeal to

241

00:07:55,510 --> 00:07:54,080

authority and the lack of a point and

242

00:07:57,749 --> 00:07:55,520

presses him some more

243

00:07:59,350 --> 00:07:57,759

basically you're saying that well first

244

00:08:02,390 --> 00:07:59,360

you actually work on these things so

245

00:08:02,869 --> 00:08:02,400

you you can be considered to know where

246

00:08:04,710 --> 00:08:02,879

you

247

00:08:06,790 --> 00:08:04,720

at least the internals but now that

248

00:08:07,749 --> 00:08:06,800

derotation device so the fact that that

249

00:08:10,790 --> 00:08:07,759

that

250

00:08:13,510 --> 00:08:10,800

argument

251
00:08:13,909 --> 00:08:13,520
and dave fails to provide any answer

252
00:08:17,110 --> 00:08:13,919
because

253
00:08:17,990 --> 00:08:17,120
he was thinking that the d rotation

254
00:08:20,230 --> 00:08:18,000
device would have

255
00:08:21,350 --> 00:08:20,240
was something like this that was a lens

256
00:08:22,950 --> 00:08:21,360
that would turn

257
00:08:25,029 --> 00:08:22,960
and so if you already have an existing

258
00:08:27,589 --> 00:08:25,039
glare then this lens

259
00:08:28,629 --> 00:08:27,599
could rotate the glare because of the

260
00:08:31,270 --> 00:08:28,639
refraction

261
00:08:31,670 --> 00:08:31,280
opposed to the reflection of a mirror

262
00:08:34,230 --> 00:08:31,680
chris

263
00:08:35,110 --> 00:08:34,240

unfortunately pretty much gives up here

264

00:08:38,149 --> 00:08:35,120

i get it

265

00:08:39,350 --> 00:08:38,159

okay i understand no you don't

266

00:08:41,029 --> 00:08:39,360

understand

267

00:08:42,870 --> 00:08:41,039

so once you see that dave really doesn't

268

00:08:44,230 --> 00:08:42,880

have a point with a d rotation or a

269

00:08:46,070 --> 00:08:44,240

point with the refraction versus

270

00:08:46,870 --> 00:08:46,080

reflection or a point with glass versus

271

00:08:48,389 --> 00:08:46,880

germanium

272

00:08:49,910 --> 00:08:48,399

then all that's left is this argument

273

00:08:51,350 --> 00:08:49,920

that you don't get glare in ir

274

00:08:53,269 --> 00:08:51,360

like this but we've already seen with

275

00:08:55,030 --> 00:08:53,279

the chilean case that you do

276

00:08:56,949 --> 00:08:55,040

this unfortunately has been an argument

277

00:08:58,949 --> 00:08:56,959

that's been going around for years

278

00:09:00,630 --> 00:08:58,959

dave is ostensibly an expert even though

279

00:09:02,230 --> 00:09:00,640

he's never worked on targeting pods

280

00:09:03,750 --> 00:09:02,240

and he didn't know that sapphire glasses

281

00:09:05,509 --> 00:09:03,760

are transparent

282

00:09:07,590 --> 00:09:05,519

but he doesn't really understand my

283

00:09:09,269 --> 00:09:07,600

arguments and since his debunking

284

00:09:11,190 --> 00:09:09,279

doesn't really make any sense then

285

00:09:13,030 --> 00:09:11,200

chris's claim that he understands is