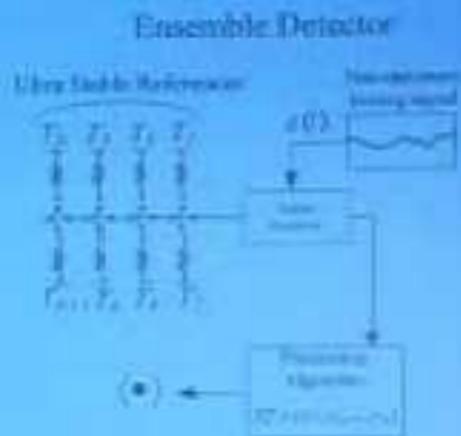


Applications of Ensemble Detection and Analysis

- Improved analyses and modeling of non linear effects of non-stationary signals passing through linear and non linear systems
- Instrument system analyses including non-stationary effects
- Improved methods for characterizing receiver stability (evaluation and specification)
- Sampling strategy optimization
- Information processing
 - Active noise cancellation
 - Control systems



1
00:00:04,870 --> 00:00:02,629
is on observation theory uh the

2
00:00:07,590 --> 00:00:04,880
background here is a

3
00:00:08,710 --> 00:00:07,600
photograph of uh of a

4
00:00:09,509 --> 00:00:08,720
plaster

5
00:00:11,910 --> 00:00:09,519
wall

6
00:00:14,470 --> 00:00:11,920
we might take a look at it and

7
00:00:15,589 --> 00:00:14,480
all agree and describe it as a brown

8
00:00:18,230 --> 00:00:15,599
wall

9
00:00:19,109 --> 00:00:18,240
but looking more closely we see that

10
00:00:20,710 --> 00:00:19,119
it

11
00:00:23,590 --> 00:00:20,720
has lots of different tones of wall and

12
00:00:26,390 --> 00:00:23,600
a lot of texture and

13
00:00:30,070 --> 00:00:26,400

describing that becomes more

14

00:00:31,910 --> 00:00:30,080

complicated say and indeed it's uh in

15

00:00:34,950 --> 00:00:31,920

the deviations from the brown where the

16

00:00:37,270 --> 00:00:34,960

beauty uh lies and

17

00:00:38,630 --> 00:00:37,280

we may say that the

18

00:00:41,510 --> 00:00:38,640

beauty is

19

00:00:43,430 --> 00:00:41,520

in the eye of the beholder

20

00:00:45,750 --> 00:00:43,440

ah

21

00:00:48,389 --> 00:00:45,760

deviate a little bit here i'm the editor

22

00:00:50,869 --> 00:00:48,399

of uh this publication earth zine it's

23

00:00:52,549 --> 00:00:50,879

an ieee publication uh and a

24

00:00:55,270 --> 00:00:52,559

contribution to the intergovernmental

25

00:00:59,110 --> 00:00:55,280

group on uh earth observation and it

26

00:01:01,590 --> 00:00:59,120

supports uh the establishment of a

27

00:01:04,869 --> 00:01:01,600

global earth observing system of systems

28

00:01:07,030 --> 00:01:04,879

and it's doing so and being designed

29

00:01:10,230 --> 00:01:07,040

around earth observation for the benefit

30

00:01:12,230 --> 00:01:10,240

of society and we may

31

00:01:14,310 --> 00:01:12,240

say well what does this have to do with

32

00:01:15,270 --> 00:01:14,320

observation theory it's

33

00:01:17,510 --> 00:01:15,280

in

34

00:01:18,630 --> 00:01:17,520

uh through observation that we become

35

00:01:20,550 --> 00:01:18,640

aware

36

00:01:22,070 --> 00:01:20,560

and this is true for the astronomer

37

00:01:25,670 --> 00:01:22,080

looking out into

38

00:01:29,830 --> 00:01:25,680

the universe and discovering new uh

39

00:01:30,630 --> 00:01:29,840

planetary systems or galaxies and uh for

40

00:01:31,830 --> 00:01:30,640

the

41

00:01:34,469 --> 00:01:31,840

monk who

42

00:01:35,830 --> 00:01:34,479

looks inward and

43

00:01:38,149 --> 00:01:35,840

discovers

44

00:01:40,870 --> 00:01:38,159

the divine or

45

00:01:43,030 --> 00:01:40,880

a mother who uh looks

46

00:01:44,069 --> 00:01:43,040

washes diligently uh

47

00:01:46,550 --> 00:01:44,079

after the

48

00:01:47,670 --> 00:01:46,560

her children um

49

00:01:50,789 --> 00:01:47,680

now

50

00:01:53,749 --> 00:01:50,799

this uh presentation deviates uh quite a

51

00:01:56,469 --> 00:01:53,759

bit from um

52

00:01:58,230 --> 00:01:56,479

uh presentations but uh the audience is

53

00:02:00,870 --> 00:01:58,240

significantly different and i imagine

54

00:02:04,230 --> 00:02:00,880

y'all uh recognize that uh the

55

00:02:05,990 --> 00:02:04,240

precognites in the audience and so uh

56

00:02:07,030 --> 00:02:06,000

i'm going to uh

57

00:02:10,949 --> 00:02:07,040

kind of

58

00:02:13,589 --> 00:02:10,959

uh into the

59

00:02:16,150 --> 00:02:13,599

gist of the theory and uh

60

00:02:18,630 --> 00:02:16,160

uh what leading to the concept of

61

00:02:20,710 --> 00:02:18,640

ensemble detection and analysis

62

00:02:23,990 --> 00:02:20,720

and um

63

00:02:25,510 --> 00:02:24,000

like to get into more uh what the

64

00:02:27,510 --> 00:02:25,520

interpretation of the underlying

65

00:02:29,430 --> 00:02:27,520

mathematics is

66

00:02:32,630 --> 00:02:29,440

pretty interesting

67

00:02:35,509 --> 00:02:32,640

now how i got into this was uh i

68

00:02:38,869 --> 00:02:35,519

designed radiometer systems and

69

00:02:41,110 --> 00:02:38,879

i found that there's not a general

70

00:02:43,110 --> 00:02:41,120

a single method and what i

71

00:02:45,589 --> 00:02:43,120

did as part of my dissertation studies

72

00:02:47,509 --> 00:02:45,599

is develop the methodology using

73

00:02:49,430 --> 00:02:47,519

measurement uncertainty as a figure of

74

00:02:51,430 --> 00:02:49,440

merit for

75

00:02:53,670 --> 00:02:51,440

comparative analysis of radiometer

76

00:02:55,670 --> 00:02:53,680

designs radiometers are

77

00:02:58,390 --> 00:02:55,680

the whole reason we

78

00:03:00,150 --> 00:02:58,400

have to have this fancy calibration

79

00:03:02,390 --> 00:03:00,160

architecture at the front of the end of

80

00:03:03,589 --> 00:03:02,400

the system is

81

00:03:05,910 --> 00:03:03,599

because

82

00:03:07,830 --> 00:03:05,920

the uh

83

00:03:10,149 --> 00:03:07,840

system response varies

84

00:03:11,589 --> 00:03:10,159

varies with time

85

00:03:15,589 --> 00:03:11,599

and um

86

00:03:18,309 --> 00:03:15,599

it's this uh temporal variability that

87

00:03:19,670 --> 00:03:18,319

leads to the non-stationary conundrum

88

00:03:20,949 --> 00:03:19,680

which is

89

00:03:23,589 --> 00:03:20,959

described

90

00:03:25,509 --> 00:03:23,599

take a look at a process at one space

91

00:03:27,350 --> 00:03:25,519

and time and you get

92

00:03:29,350 --> 00:03:27,360

one answer and look at it at a different

93

00:03:31,110 --> 00:03:29,360

place you get a get a different set of

94

00:03:34,149 --> 00:03:31,120

statistics and

95

00:03:37,990 --> 00:03:34,159

currently we really don't have a

96

00:03:39,910 --> 00:03:38,000

very good way of describing that well

97

00:03:43,910 --> 00:03:39,920

and i thought ran into this problem in

98

00:03:45,110 --> 00:03:43,920

developing a generalized methodology

99

00:03:48,309 --> 00:03:45,120

here

100

00:03:50,789 --> 00:03:48,319

uh you see a radiometer system with gain

101
00:03:54,949 --> 00:03:50,799
fluctuations and the gain fluctuations

102
00:03:57,589 --> 00:03:54,959
uh in observing each one of the uh

103
00:04:00,309 --> 00:03:57,599
temperature references appear

104
00:04:02,710 --> 00:04:00,319
as uh in each of the time series of the

105
00:04:04,869 --> 00:04:02,720
different references now what we do in

106
00:04:07,429 --> 00:04:04,879
radiometry is we apply

107
00:04:10,309 --> 00:04:07,439
a calibration algorithm f which combines

108
00:04:12,470 --> 00:04:10,319
the calibration references in making an

109
00:04:15,509 --> 00:04:12,480
estimate of what

110
00:04:17,670 --> 00:04:15,519
the brightness temperature is

111
00:04:19,349 --> 00:04:17,680
and we can

112
00:04:22,629 --> 00:04:19,359
take a look at what the uncertainty in

113
00:04:24,950 --> 00:04:22,639

the estimate is by uh and here i i show

114

00:04:27,189 --> 00:04:24,960

some analysis with the data and i uh the

115

00:04:29,830 --> 00:04:27,199

brackets here are the uh statistical

116

00:04:33,030 --> 00:04:29,840

operation

117

00:04:36,310 --> 00:04:33,040

statistical calculation from the data

118

00:04:38,469 --> 00:04:36,320

and we see that using a

119

00:04:40,310 --> 00:04:38,479

two pair algorithm using two pairs of

120

00:04:41,270 --> 00:04:40,320

calibration measurements to estimate

121

00:04:43,430 --> 00:04:41,280

what the

122

00:04:46,150 --> 00:04:43,440

brightness temperature at at some

123

00:04:48,469 --> 00:04:46,160

different time is and we can slide and

124

00:04:50,230 --> 00:04:48,479

slide this time across and what we see

125

00:04:51,909 --> 00:04:50,240

is we get minimum uncertainty at the

126
00:04:53,030 --> 00:04:51,919
time when

127
00:04:57,510 --> 00:04:53,040
the

128
00:04:59,350 --> 00:04:57,520
calibration a local maximum when it's

129
00:05:00,790 --> 00:04:59,360
right in between a local minimum and we

130
00:05:02,710 --> 00:05:00,800
can uh

131
00:05:06,150 --> 00:05:02,720
i've done i showed this for for

132
00:05:09,830 --> 00:05:06,160
different t1's now what

133
00:05:11,110 --> 00:05:09,840
enables this uh type of analysis is is

134
00:05:13,749 --> 00:05:11,120
that

135
00:05:17,510 --> 00:05:13,759
we have a collection of ensemble data

136
00:05:20,390 --> 00:05:17,520
which uh uh describes the the which has

137
00:05:22,710 --> 00:05:20,400
the fluctuations of the receiver

138
00:05:27,189 --> 00:05:24,230

the challenge challenges is in in

139

00:05:30,150 --> 00:05:27,199

modeling this okay taking um you know

140

00:05:33,110 --> 00:05:30,160

calculating what the uh uncertainty is

141

00:05:36,390 --> 00:05:33,120

from from uh

142

00:05:39,110 --> 00:05:36,400

a model and uh as

143

00:05:42,310 --> 00:05:39,120

leave it here now

144

00:05:44,150 --> 00:05:42,320

calibration has a few different things

145

00:05:47,670 --> 00:05:44,160

does a few different things for us one

146

00:05:50,950 --> 00:05:47,680

is it provides scale which we can assign

147

00:05:53,510 --> 00:05:50,960

value another is is that

148

00:05:55,830 --> 00:05:53,520

from that we are able to

149

00:05:58,070 --> 00:05:55,840

distinguish uh say a signal from

150

00:06:01,670 --> 00:05:58,080

background noise another thing that

151
00:06:04,629 --> 00:06:01,680
calibration does is it provides the

152
00:06:06,790 --> 00:06:04,639
means of comparing measurements made at

153
00:06:09,590 --> 00:06:06,800
one place in time say here in boulder

154
00:06:12,230 --> 00:06:09,600
yesterday to a measurement made tomorrow

155
00:06:15,350 --> 00:06:12,240
in france and it's these properties of

156
00:06:16,790 --> 00:06:15,360
calibration that make it very useful to

157
00:06:18,710 --> 00:06:16,800
studying and characterizing

158
00:06:20,710 --> 00:06:18,720
non-stationary prop

159
00:06:22,790 --> 00:06:20,720
non-stationary processes

160
00:06:25,350 --> 00:06:22,800
and there's lots of different uh

161
00:06:28,230 --> 00:06:25,360
approaches and uh to modeling and

162
00:06:31,189 --> 00:06:28,240
characterizing non-stationary processes

163
00:06:33,029 --> 00:06:31,199

that have been say fashionable over the

164

00:06:36,150 --> 00:06:33,039

years and

165

00:06:38,550 --> 00:06:36,160

more recently uh there's uh work by

166

00:06:40,230 --> 00:06:38,560

norton long and all uh empirical mode

167

00:06:43,830 --> 00:06:40,240

decomposition and

168

00:06:47,110 --> 00:06:43,840

uh all these have uh something in common

169

00:06:49,430 --> 00:06:47,120

is that they uh they're based upon a

170

00:06:50,870 --> 00:06:49,440

single realization of the data

171

00:06:56,469 --> 00:06:50,880

and

172

00:06:58,309 --> 00:06:56,479

analysis as a new method that

173

00:06:59,990 --> 00:06:58,319

complements these

174

00:07:02,629 --> 00:07:00,000

previous things

175

00:07:05,110 --> 00:07:02,639

looking more closely at at this

176

00:07:08,309 --> 00:07:05,120

stochastic process theory is kind of an

177

00:07:10,070 --> 00:07:08,319

outgrowth of probability theory where uh

178

00:07:29,270 --> 00:07:10,080

a

179

00:07:31,749 --> 00:07:29,280

ensemble set of

180

00:07:32,950 --> 00:07:31,759

time series well all these kind of

181

00:07:35,749 --> 00:07:32,960

exist

182

00:07:38,230 --> 00:07:35,759

say simultaneously and what we get

183

00:07:41,350 --> 00:07:38,240

from a single realization is a selection

184

00:07:43,029 --> 00:07:41,360

of one of these and this uh treatment of

185

00:07:43,909 --> 00:07:43,039

mathematics

186

00:07:47,430 --> 00:07:43,919

is has

187

00:07:49,589 --> 00:07:47,440

led to the auto correlation function and

188

00:07:51,749 --> 00:07:49,599

lots of uh

189

00:07:53,749 --> 00:07:51,759

from which we can

190

00:07:56,070 --> 00:07:53,759

calculate what the what the variance of

191

00:07:56,950 --> 00:07:56,080

the process is

192

00:07:58,869 --> 00:07:56,960

but

193

00:08:01,990 --> 00:07:58,879

there's really really a problem and this

194

00:08:03,110 --> 00:08:02,000

has been been a stigma in applying

195

00:08:08,469 --> 00:08:03,120

uh

196

00:08:11,189 --> 00:08:08,479

theory more broadly in in

197

00:08:14,629 --> 00:08:11,199

uh science and engineering practices and

198

00:08:17,110 --> 00:08:14,639

and that is that the uh ensemble

199

00:08:19,270 --> 00:08:17,120

statistics that that we get don't really

200

00:08:21,830 --> 00:08:19,280

match uh the

201
00:08:24,710 --> 00:08:21,840
measurements we get whenever we change

202
00:08:27,749 --> 00:08:24,720
the observation interval and

203
00:08:30,710 --> 00:08:27,759
that can be

204
00:08:32,709 --> 00:08:30,720
part of the problem i see is that the

205
00:08:34,949 --> 00:08:32,719
ensemble changes

206
00:08:38,389 --> 00:08:34,959
you know processes uh

207
00:08:39,190 --> 00:08:38,399
processes die and are born

208
00:08:40,389 --> 00:08:39,200
and

209
00:08:43,430 --> 00:08:40,399
alternatively

210
00:08:44,149 --> 00:08:43,440
and this kind of com has come out of uh

211
00:08:48,630 --> 00:08:44,159
the

212
00:08:50,870 --> 00:08:48,640
treatment of uh

213
00:08:52,070 --> 00:08:50,880

the uncertainty where uh

214

00:09:03,030 --> 00:08:52,080

i

215

00:09:04,870 --> 00:09:03,040

process um

216

00:09:06,710 --> 00:09:04,880

in estimating the mean value at one

217

00:09:08,389 --> 00:09:06,720

point in time from a measurement made at

218

00:09:10,949 --> 00:09:08,399

a different point in time

219

00:09:14,710 --> 00:09:10,959

and uh this

220

00:09:16,310 --> 00:09:14,720

uh and so during an uh kind of uh treat

221

00:09:19,030 --> 00:09:16,320

instead of the the process is

222

00:09:22,070 --> 00:09:19,040

non-stationary treated as a as an array

223

00:09:24,870 --> 00:09:22,080

of uh random events with each event

224

00:09:26,550 --> 00:09:24,880

having a conditional probability

225

00:09:27,509 --> 00:09:26,560

density function

226
00:09:28,710 --> 00:09:27,519
and

227
00:09:31,190 --> 00:09:28,720
the

228
00:09:32,070 --> 00:09:31,200
each random variable has

229
00:09:36,710 --> 00:09:32,080
the

230
00:09:39,829 --> 00:09:36,720
applied

231
00:09:39,839 --> 00:09:45,030
depends upon how how it's used and

232
00:09:48,949 --> 00:09:45,910
this

233
00:09:51,350 --> 00:09:48,959
kind of formulations kind of led me to

234
00:09:54,070 --> 00:09:51,360
realize that hey this has a

235
00:09:56,630 --> 00:09:54,080
connection with say conscious

236
00:09:59,590 --> 00:09:56,640
phenomena or or the experience that how

237
00:10:03,910 --> 00:10:01,750
an event in time

238
00:10:05,350 --> 00:10:03,920

be interpreted in two completely

239

00:10:06,870 --> 00:10:05,360

different ways

240

00:10:09,990 --> 00:10:06,880

from different points of time and it's

241

00:10:12,870 --> 00:10:10,000

about this uh when i was looking at this

242

00:10:14,630 --> 00:10:12,880

that a a friend of mine pointed me to

243

00:10:15,590 --> 00:10:14,640

the work of

244

00:10:18,710 --> 00:10:15,600

robert

245

00:10:20,710 --> 00:10:18,720

john and brenda dunn and i

246

00:10:21,910 --> 00:10:20,720

realized that you know what they were

247

00:10:25,110 --> 00:10:21,920

doing with

248

00:10:30,069 --> 00:10:27,509

the field regs and the random event

249

00:10:31,110 --> 00:10:30,079

generators it was based upon noise

250

00:10:33,190 --> 00:10:31,120

measurements

251

00:10:35,110 --> 00:10:33,200

using a circuit much like

252

00:10:37,030 --> 00:10:35,120

we use in radiometry kind of like a

253

00:10:39,910 --> 00:10:37,040

dickey radiometer circuit

254

00:10:42,389 --> 00:10:39,920

so and that's how i came about

255

00:10:45,590 --> 00:10:42,399

being here and i certainly appreciate uh

256

00:10:48,389 --> 00:10:45,600

been pointing me in this direction

257

00:10:51,990 --> 00:10:48,399

here's a few uncertainty models uh kind

258

00:10:54,710 --> 00:10:52,000

of different for a stationary process uh

259

00:10:57,350 --> 00:10:54,720

the uncertainty is independent really of

260

00:11:00,230 --> 00:10:57,360

of the temporal separation between pc

261

00:11:02,550 --> 00:11:00,240

and ta here for a

262

00:11:05,110 --> 00:11:02,560

non-station uncertainty

263

00:11:07,269 --> 00:11:05,120

the uncertainty is minimum at the same

264

00:11:09,590 --> 00:11:07,279

time and increases uh

265

00:11:11,670 --> 00:11:09,600

way and we can have local stationary

266

00:11:14,310 --> 00:11:11,680

local non-stationary and

267

00:11:16,870 --> 00:11:14,320

here's an asymmetric uncertain certainty

268

00:11:19,509 --> 00:11:16,880

and these are uh kind of models that

269

00:11:22,710 --> 00:11:19,519

i've i've used in in my data this is a

270

00:11:25,430 --> 00:11:22,720

parametric fit to uh some radiometer

271

00:11:28,230 --> 00:11:25,440

data that i showed previously saying

272

00:11:29,269 --> 00:11:28,240

data and i'm using a four parameter

273

00:11:30,949 --> 00:11:29,279

model here

274

00:11:32,230 --> 00:11:30,959

to to

275

00:11:35,910 --> 00:11:32,240

characterize the

276

00:11:37,829 --> 00:11:35,920

the uh to a linear fit for the

277

00:11:39,750 --> 00:11:37,839

uncertainty and a linear fit to the

278

00:11:41,509 --> 00:11:39,760

correlation

279

00:11:44,630 --> 00:11:41,519

and

280

00:11:45,910 --> 00:11:44,640

what's interesting is that you know uh

281

00:11:50,550 --> 00:11:45,920

there's

282

00:11:53,990 --> 00:11:50,560

features in the this data uh

283

00:11:56,150 --> 00:11:54,000

but uh you see uh there's a core

284

00:11:59,350 --> 00:11:56,160

correlation at

285

00:12:01,829 --> 00:11:59,360

aspect when uh the the two pairs of

286

00:12:05,269 --> 00:12:01,839

calibration measurements are close in in

287

00:12:08,230 --> 00:12:05,279

uh time uh they produce a higher

288

00:12:10,030 --> 00:12:08,240

uncertainty whenever the uh

289

00:12:13,190 --> 00:12:10,040

calibration algorithm is

290

00:12:14,710 --> 00:12:13,200

extrapolated then uh as you separate so

291

00:12:16,629 --> 00:12:14,720

that kind of indicates another

292

00:12:18,949 --> 00:12:16,639

interesting feature as you take a look

293

00:12:21,110 --> 00:12:18,959

that uh if

294

00:12:24,389 --> 00:12:21,120

on on this side the

295

00:12:27,590 --> 00:12:24,399

uh uncertainty is is higher than what

296

00:12:29,990 --> 00:12:27,600

the model is and on this side it's

297

00:12:31,509 --> 00:12:30,000

lower you can see that in this red curve

298

00:12:33,269 --> 00:12:31,519

here well

299

00:12:35,269 --> 00:12:33,279

that indicates that the

300

00:12:38,310 --> 00:12:35,279

for this data set the

301
00:12:41,910 --> 00:12:38,320
calibration has greater uncertainty in

302
00:12:43,350 --> 00:12:41,920
uh estimating a future value than in in

303
00:12:44,150 --> 00:12:43,360
the past

304
00:12:49,190 --> 00:12:44,160
the

305
00:12:50,710 --> 00:12:49,200
in in this data set

306
00:12:54,230 --> 00:12:50,720
and

307
00:12:57,509 --> 00:12:54,240
using uh a one parameter asymmetry term

308
00:13:00,150 --> 00:12:57,519
and in my model i can uh uh correct for

309
00:13:02,550 --> 00:13:00,160
that and and get a really pretty nice

310
00:13:05,350 --> 00:13:02,560
fit and you can see that indeed there's

311
00:13:06,629 --> 00:13:05,360
there's an asymmetry in the model

312
00:13:08,150 --> 00:13:06,639
well

313
00:13:09,030 --> 00:13:08,160

two minutes okay

314

00:13:18,470 --> 00:13:09,040

uh

315

00:13:21,110 --> 00:13:18,480

has been applied to radiometry but it is

316

00:13:23,350 --> 00:13:21,120

any generalized uh too

317

00:13:25,670 --> 00:13:23,360

the math is very

318

00:13:28,150 --> 00:13:25,680

generalized and so

319

00:13:30,389 --> 00:13:28,160

the thought is to uh use calibrated

320

00:13:32,870 --> 00:13:30,399

noise uh in characterizing

321

00:13:34,790 --> 00:13:32,880

non-stationary forcing functions in

322

00:13:37,269 --> 00:13:34,800

uh what i call

323

00:13:39,110 --> 00:13:37,279

ensemble detection and analysis

324

00:13:43,190 --> 00:13:39,120

here

325

00:13:45,590 --> 00:13:43,200

applications one of the really neat

326

00:13:46,870 --> 00:13:45,600

things about this is that there are a

327

00:13:48,710 --> 00:13:46,880

wide number of

328

00:13:51,350 --> 00:13:48,720

applications that

329

00:13:54,389 --> 00:13:51,360

from instrument system analysis and

330

00:13:57,030 --> 00:13:54,399

sampling strategy optimization and

331

00:13:59,829 --> 00:13:57,040

in information processing which

332

00:14:02,069 --> 00:13:59,839

is uh quite useful i mean

333

00:14:04,949 --> 00:14:02,079

this is uh

334

00:14:08,150 --> 00:14:04,959

shows how a model can be uh

335

00:14:11,189 --> 00:14:08,160

used in uh say

336

00:14:13,509 --> 00:14:11,199

optimizing sampling strategy uh nasa be

337

00:14:16,150 --> 00:14:13,519

interested in this and

338

00:14:18,230 --> 00:14:16,160

determining well with uh one satellite

339

00:14:20,230 --> 00:14:18,240

we can sample uh

340

00:14:21,990 --> 00:14:20,240

with such a frequency and get get this

341

00:14:23,509 --> 00:14:22,000

type of uncertainty this level of

342

00:14:26,069 --> 00:14:23,519

uncertainty but if we use three

343

00:14:28,470 --> 00:14:26,079

satellites we can increase the sampling

344

00:14:30,790 --> 00:14:28,480

frequency and and uh improve the

345

00:14:33,670 --> 00:14:30,800

uncertainty and the measurement

346

00:14:37,350 --> 00:14:33,680

and has uh application to to climate

347

00:14:39,829 --> 00:14:37,360

modeling as i show uh here it's uh

348

00:14:41,910 --> 00:14:39,839

interesting there's a uh other

349

00:14:43,590 --> 00:14:41,920

uh works are being published that i've

350

00:14:45,750 --> 00:14:43,600

seen in in the

351
00:14:46,710 --> 00:14:45,760
past few few years

352
00:14:53,110 --> 00:14:46,720
of

353
00:14:57,269 --> 00:14:55,590
finish up here with the

354
00:14:58,870 --> 00:14:57,279
interpretation of the mathematics what

355
00:15:00,230 --> 00:14:58,880
the mathematics

356
00:15:01,590 --> 00:15:00,240
means

357
00:15:02,870 --> 00:15:01,600
is

358
00:15:05,430 --> 00:15:02,880
that

359
00:15:08,870 --> 00:15:05,440
the time space comprise an array of

360
00:15:10,310 --> 00:15:08,880
events across which a stochastic wave

361
00:15:11,509 --> 00:15:10,320
propagates

362
00:15:14,150 --> 00:15:11,519
and

363
00:15:16,389 --> 00:15:14,160

the the present is characterized by

364

00:15:18,069 --> 00:15:16,399

minimum uncertainty uh

365

00:15:19,990 --> 00:15:18,079

and uh that

366

00:15:24,230 --> 00:15:20,000

time points in the direction of greater

367

00:15:25,269 --> 00:15:24,240

uncertainty if uh the past is equally

368

00:15:28,069 --> 00:15:25,279

uncertain

369

00:15:30,069 --> 00:15:28,079

as the future the the process would be

370

00:15:33,910 --> 00:15:30,079

uh stationary

371

00:15:37,269 --> 00:15:33,920

um and uh observation uh the outcome

372

00:15:39,509 --> 00:15:37,279

depends upon this perspective and uh as

373

00:15:40,389 --> 00:15:39,519

as well as uh the

374

00:15:45,990 --> 00:15:40,399

uh

375

00:15:47,829 --> 00:15:46,000

the the the values that we assign to our

376

00:15:49,350 --> 00:15:47,839

references and the way we use those

377

00:15:53,110 --> 00:15:49,360

references and

378

00:15:56,230 --> 00:15:53,120

and assigning value to uh our outcomes

379

00:15:57,110 --> 00:15:56,240

that we observe uh the

380

00:16:04,150 --> 00:15:57,120

character

381

00:16:07,030 --> 00:16:04,160

of this stochastic wave uh and uh the uh

382

00:16:10,150 --> 00:16:07,040

value of uncertainty depends upon uh the

383

00:16:12,870 --> 00:16:10,160

waiting of uh the future and and and

384

00:16:15,670 --> 00:16:12,880

past and uh and finally ensemble

385

00:16:18,710 --> 00:16:15,680

detection provides a means of uh

386

00:16:21,189 --> 00:16:18,720

detecting this uh stochastic wave

387

00:16:22,949 --> 00:16:21,199

you know i may uh stop there got a

388

00:16:32,230 --> 00:16:22,959

couple more but i'd certainly like to

389

00:16:34,550 --> 00:16:33,189

are there

390

00:16:36,550 --> 00:16:34,560

any questions

391

00:16:38,470 --> 00:16:36,560

yes i have a question uh thank you very

392

00:16:40,710 --> 00:16:38,480

much you've given me a lot to think

393

00:16:43,269 --> 00:16:40,720

about years ago i did a lot of signal

394

00:16:45,030 --> 00:16:43,279

analysis work and i'm wondering if

395

00:16:47,749 --> 00:16:45,040

you probably said it i didn't quite

396

00:16:49,910 --> 00:16:47,759

grasp it the connection between pattern

397

00:16:51,509 --> 00:16:49,920

adaptive pattern recognition as used in

398

00:16:52,949 --> 00:16:51,519

signal processing and what you're

399

00:16:55,110 --> 00:16:52,959

talking about here

400

00:16:59,509 --> 00:16:55,120

how do those correlate

401
00:17:02,310 --> 00:17:00,310
this

402
00:17:05,669 --> 00:17:02,320
technique ensemble detection and

403
00:17:07,029 --> 00:17:05,679
analysis certainly has uh application to

404
00:17:15,669 --> 00:17:07,039
uh

405
00:17:27,350 --> 00:17:15,679
i

406
00:17:28,390 --> 00:17:27,360
between

407
00:17:31,830 --> 00:17:28,400
um

408
00:17:35,590 --> 00:17:31,840
sampled events uh and in terms of uh its

409
00:17:40,470 --> 00:17:35,600
utilization one is coming up with a uh

410
00:17:45,110 --> 00:17:42,950
evaluating calculating what a a

411
00:17:47,990 --> 00:17:45,120
stochastic parametric model which

412
00:17:50,630 --> 00:17:48,000
describes that data and then uh take new

413
00:17:53,430 --> 00:17:50,640

data coming in and and compare

414

00:17:57,590 --> 00:17:53,440

the the data and either we detect a

415

00:18:00,710 --> 00:17:57,600

change or uh uh adapt that the model

416

00:18:03,110 --> 00:18:00,720

kind of like that

417

00:18:04,390 --> 00:18:03,120

so perhaps following from that question

418

00:18:06,230 --> 00:18:04,400

uh

419

00:18:09,029 --> 00:18:06,240

it would be helpful to me

420

00:18:14,549 --> 00:18:09,039

can you give a specific example

421

00:18:17,830 --> 00:18:14,559

of say a random event generator output

422

00:18:20,549 --> 00:18:17,840

something like from the pair lab

423

00:18:22,789 --> 00:18:20,559

how you would analyze it what would you

424

00:18:26,070 --> 00:18:22,799

take what would you do with that data

425

00:18:27,350 --> 00:18:26,080

and how would that help in understanding

426

00:18:31,750 --> 00:18:27,360

uh

427

00:18:32,789 --> 00:18:31,760

effects

428

00:18:36,070 --> 00:18:32,799

yeah

429

00:18:38,710 --> 00:18:36,080

that's an interesting question and i uh

430

00:18:42,150 --> 00:18:38,720

have some thoughts about how to

431

00:18:46,390 --> 00:18:42,160

kind of uh adapt the the regs to uh

432

00:18:47,270 --> 00:18:46,400

using this technique really it's uh

433

00:18:52,870 --> 00:18:47,280

in

434

00:18:57,830 --> 00:18:52,880

series of random events from say a

435

00:19:00,070 --> 00:18:57,840

a single noise source use uh

436

00:19:01,909 --> 00:19:00,080

and having that be the the

437

00:19:04,549 --> 00:19:01,919

the control signal that we're looking at

438

00:19:07,669 --> 00:19:04,559

as you know how it goes up and goes down

439

00:19:10,630 --> 00:19:07,679

and uh the role uh

440

00:19:13,350 --> 00:19:10,640

have the say the control signal that is

441

00:19:16,150 --> 00:19:13,360

being analyzed be the

442

00:19:19,510 --> 00:19:17,430

gain of the

443

00:19:20,470 --> 00:19:19,520

of the receiver say

444

00:19:21,270 --> 00:19:20,480

and

445

00:19:23,270 --> 00:19:21,280

use

446

00:19:27,830 --> 00:19:23,280

calibrated noise

447

00:19:31,669 --> 00:19:28,789

to

448

00:19:34,549 --> 00:19:31,679

detect changes in that game

449

00:19:36,150 --> 00:19:34,559

that would allow

450

00:19:38,470 --> 00:19:36,160

more

451

00:19:41,830 --> 00:19:38,480

temporal processing of the data say

452

00:19:46,310 --> 00:19:41,840

being able to apply uh a calibration

453

00:19:51,190 --> 00:19:48,630

fluctuations that are being seen during

454

00:19:53,510 --> 00:19:51,200

say an event of interest

455

00:19:55,590 --> 00:19:53,520

as you may know the roger nelson's

456

00:19:57,750 --> 00:19:55,600

global consciousness project has all of

457

00:19:59,830 --> 00:19:57,760

its data available online

458

00:20:02,070 --> 00:19:59,840

and it may be really interesting for

459

00:20:02,870 --> 00:20:02,080

someone with your perspective to take a

460

00:20:05,750 --> 00:20:02,880

look

461

00:20:09,110 --> 00:20:05,760

at that data and just see if you can

462

00:20:11,270 --> 00:20:09,120

glean uh different information from it

463

00:20:15,510 --> 00:20:11,280

yeah

464

00:20:17,990 --> 00:20:15,520

certainly i i'm uh interested in in uh

465

00:20:21,350 --> 00:20:19,510

it's

466

00:20:24,310 --> 00:20:21,360

you know i um

467

00:20:27,669 --> 00:20:24,320

um see uh

468

00:20:30,710 --> 00:20:27,679

advantages in kind of uh adapting the

469

00:20:34,470 --> 00:20:30,720

design where instead of using like a

470

00:20:39,590 --> 00:20:34,480

a single uh random event generator

471

00:20:43,350 --> 00:20:39,600

uh albeit um the eggs are discrete but

472

00:20:45,750 --> 00:20:43,360

uh coupling them together and using uh

473

00:20:48,710 --> 00:20:45,760

a random event generator with uh

474

00:20:52,230 --> 00:20:48,720

calibrated noise with and and when i say

475

00:20:53,830 --> 00:20:52,240

calibrated noisy uh the the noise has

476

00:20:56,549 --> 00:20:53,840

and uh

477

00:21:00,470 --> 00:20:56,559

has different noise power levels to it

478

00:21:03,270 --> 00:21:00,480

which have an a priori uh

479

00:21:05,830 --> 00:21:03,280

statistical relationship from which you

480

00:21:06,870 --> 00:21:05,840

can detect deviations from