

WEBVTT

NOTE duration: "00:22:52.544"

NOTE Confidence: 0.8941206

00:00:00.080 --> 00:00:01.839 It's my our colleague, Hui

NOTE Confidence: 0.8941206

00:00:01.839 --> 00:00:02.740 Kao from,

NOTE Confidence: 0.90049

00:00:03.520 --> 00:00:04.960 applied physics and physics in

NOTE Confidence: 0.90049

00:00:04.960 --> 00:00:06.500 in the school of, engineering.

NOTE Confidence: 0.9479316

00:00:07.279 --> 00:00:08.880 So, Hui, it's, the John

NOTE Confidence: 0.9479316

00:00:08.880 --> 00:00:10.660 Malone professor of applied physics,

NOTE Confidence: 0.96641284

00:00:11.599 --> 00:00:13.519 and, her research focuses on

NOTE Confidence: 0.96641284

00:00:13.519 --> 00:00:14.019 mesoscopic

NOTE Confidence: 0.921484

00:00:14.320 --> 00:00:15.780 physics, complex nanophotonics,

NOTE Confidence: 0.8957001

00:00:16.505 --> 00:00:17.145 she got her PhD in

NOTE Confidence: 0.8957001

00:00:17.145 --> 00:00:17.704 applied physics from Stanford, and

NOTE Confidence: 0.8957001

00:00:17.704 --> 00:00:18.204 then,

NOTE Confidence: 0.95934904

00:00:19.545 --> 00:00:19.799 she was on the faculty

NOTE Confidence: 0.95934904

00:00:19.799 --> 00:00:20.054 for Northwestern before she joined

NOTE Confidence: 0.95934904

00:00:20.054 --> 00:00:20.105 Yale,
NOTE Confidence: 0.9163325

00:00:20.904 --> 00:00:23.324 lucky for us. And, she's
NOTE Confidence: 0.9163325

00:00:23.385 --> 00:00:25.625 been a a a pioneer
NOTE Confidence: 0.9163325

00:00:25.625 --> 00:00:26.364 and leader in
NOTE Confidence: 0.89752156

00:00:30.350 --> 00:00:31.950 on random, working on random
NOTE Confidence: 0.89752156

00:00:31.950 --> 00:00:34.030 lasers. And and recently, she's
NOTE Confidence: 0.89752156

00:00:34.030 --> 00:00:35.310 been, working on,
NOTE Confidence: 0.9294159

00:00:36.030 --> 00:00:37.550 trying to see do deep
NOTE Confidence: 0.9294159

00:00:37.550 --> 00:00:38.830 tissue imaging, and I think
NOTE Confidence: 0.9294159

00:00:38.830 --> 00:00:39.950 that's what she's gonna talk
NOTE Confidence: 0.9294159

00:00:39.950 --> 00:00:41.310 about. And doctor Kao is
NOTE Confidence: 0.9294159

00:00:41.310 --> 00:00:42.270 an elected member of the
NOTE Confidence: 0.9294159

00:00:42.270 --> 00:00:44.110 National Academy of Sciences and
NOTE Confidence: 0.9294159

00:00:44.110 --> 00:00:46.005 also the, American Academy of
NOTE Confidence: 0.9294159

00:00:46.005 --> 00:00:47.705 Arts and Sciences. So, Huey?
NOTE Confidence: 0.96479565

00:00:54.405 --> 00:00:55.205 Let me try to see

NOTE Confidence: 0.96479565

00:00:55.205 --> 00:00:56.265 if I can find it.

NOTE Confidence: 0.96479565

00:00:56.405 --> 00:00:57.685 Okay. So first, it's a

NOTE Confidence: 0.96479565

00:00:57.685 --> 00:00:58.725 great pleasure for me to

NOTE Confidence: 0.96479565

00:00:58.725 --> 00:00:59.765 give this talk. I'd like

NOTE Confidence: 0.96479565

00:00:59.765 --> 00:01:00.885 to thank John for this

NOTE Confidence: 0.96479565

00:01:00.885 --> 00:01:01.385 invitation.

NOTE Confidence: 0.9425647

00:01:02.700 --> 00:01:03.740 I'm really trained as a

NOTE Confidence: 0.9425647

00:01:03.740 --> 00:01:05.420 physicist, and I'm doing applied

NOTE Confidence: 0.9425647

00:01:05.420 --> 00:01:06.480 physics engineering.

NOTE Confidence: 0.9124064

00:01:06.860 --> 00:01:07.900 I know nothing about the

NOTE Confidence: 0.9124064

00:01:07.900 --> 00:01:08.720 immune system,

NOTE Confidence: 0.9525363

00:01:09.180 --> 00:01:09.980 but I would love to,

NOTE Confidence: 0.9525363

00:01:09.980 --> 00:01:11.180 you know, see whether I

NOTE Confidence: 0.9525363

00:01:11.180 --> 00:01:12.459 can, you know, collaborate with

NOTE Confidence: 0.9525363

00:01:12.459 --> 00:01:13.980 people here at your medical

NOTE Confidence: 0.9525363

00:01:13.980 --> 00:01:14.480 school.
NOTE Confidence: 0.96144307

00:01:15.194 --> 00:01:16.315 So my talk, I'm gonna
NOTE Confidence: 0.96144307

00:01:16.315 --> 00:01:18.075 start with the introduction about
NOTE Confidence: 0.96144307

00:01:18.075 --> 00:01:20.395 my my previous work as
NOTE Confidence: 0.96144307

00:01:20.395 --> 00:01:21.435 I'm trying to show what
NOTE Confidence: 0.96144307

00:01:21.435 --> 00:01:22.395 we're trying to do right
NOTE Confidence: 0.96144307

00:01:22.395 --> 00:01:24.075 now. Hopefully, you know, this
NOTE Confidence: 0.96144307

00:01:24.075 --> 00:01:24.955 will just to give you
NOTE Confidence: 0.96144307

00:01:24.955 --> 00:01:25.995 some idea what I'm doing,
NOTE Confidence: 0.96144307

00:01:25.995 --> 00:01:27.275 and I'm very much looking
NOTE Confidence: 0.96144307

00:01:27.275 --> 00:01:28.970 forward to, you know, talking
NOTE Confidence: 0.96144307

00:01:28.970 --> 00:01:30.009 with you and see what
NOTE Confidence: 0.96144307

00:01:30.009 --> 00:01:31.450 are the potential collaboration we
NOTE Confidence: 0.96144307

00:01:31.450 --> 00:01:32.189 could have.
NOTE Confidence: 0.9814892

00:01:32.890 --> 00:01:33.209 So,
NOTE Confidence: 0.9100256

00:01:33.850 --> 00:01:35.369 okay. So this is, actually,

NOTE Confidence: 0.9100256
00:01:35.530 --> 00:01:36.970 my title. But before that,
NOTE Confidence: 0.9100256
00:01:36.970 --> 00:01:38.170 as I said, I want
NOTE Confidence: 0.9100256
00:01:38.170 --> 00:01:39.290 to talk a little bit
NOTE Confidence: 0.9100256
00:01:39.290 --> 00:01:40.250 of what we have what
NOTE Confidence: 0.9100256
00:01:40.250 --> 00:01:41.715 I've been doing, especially kind
NOTE Confidence: 0.9100256
00:01:41.715 --> 00:01:42.915 of you can collaborate with
NOTE Confidence: 0.9100256
00:01:42.915 --> 00:01:44.535 people at your medical school.
NOTE Confidence: 0.9910742
00:01:45.075 --> 00:01:47.155 So I'm, doing optics. Right?
NOTE Confidence: 0.9910742
00:01:47.155 --> 00:01:48.595 So I think for optical
NOTE Confidence: 0.9910742
00:01:48.595 --> 00:01:49.095 imaging,
NOTE Confidence: 0.9857765
00:01:49.395 --> 00:01:50.915 what is really important, it
NOTE Confidence: 0.9857765
00:01:50.915 --> 00:01:52.195 is the light source for
NOTE Confidence: 0.9857765
00:01:52.195 --> 00:01:52.695 illumination.
NOTE Confidence: 0.8996617
00:01:53.490 --> 00:01:55.250 And especially for wide field
NOTE Confidence: 0.8996617
00:01:55.250 --> 00:01:56.630 imaging like a microscope,
NOTE Confidence: 0.935437

00:01:57.090 --> 00:01:58.550 we all know that mostly
NOTE Confidence: 0.935437

00:01:58.690 --> 00:02:00.290 people using, you know, a
NOTE Confidence: 0.935437

00:02:00.290 --> 00:02:02.390 lamp or LUD. Right?
NOTE Confidence: 0.9397959

00:02:03.010 --> 00:02:04.370 But, those are has a
NOTE Confidence: 0.9397959

00:02:04.370 --> 00:02:05.890 limited intensity. If you want
NOTE Confidence: 0.9397959

00:02:05.890 --> 00:02:06.390 to,
NOTE Confidence: 0.9110064

00:02:08.125 --> 00:02:10.044 tissue or get into some
NOTE Confidence: 0.9110064

00:02:10.044 --> 00:02:11.264 material has some absorption,
NOTE Confidence: 0.98734975

00:02:11.645 --> 00:02:13.025 this may not be sufficient,
NOTE Confidence: 0.98734975

00:02:13.165 --> 00:02:14.465 you know, enough intensity.
NOTE Confidence: 0.9413788

00:02:15.005 --> 00:02:16.285 So of of course, you
NOTE Confidence: 0.9413788

00:02:16.285 --> 00:02:17.245 know, people to say, how
NOTE Confidence: 0.9413788

00:02:17.245 --> 00:02:18.364 about we go to lasers?
NOTE Confidence: 0.9413788

00:02:18.364 --> 00:02:19.885 Because laser is much, you
NOTE Confidence: 0.9413788

00:02:19.885 --> 00:02:20.785 know, brighter.
NOTE Confidence: 0.96491486

00:02:21.150 --> 00:02:22.829 Right? So that is, you

NOTE Confidence: 0.96491486
00:02:22.829 --> 00:02:24.129 know, really or superluminescent
NOTE Confidence: 0.9493352
00:02:24.510 --> 00:02:26.030 LED. You have a, you
NOTE Confidence: 0.9493352
00:02:26.030 --> 00:02:27.629 know, you know, much stronger
NOTE Confidence: 0.9493352
00:02:27.629 --> 00:02:29.650 signal or much stronger excitation.
NOTE Confidence: 0.9779065
00:02:30.909 --> 00:02:31.709 But I want to show
NOTE Confidence: 0.9779065
00:02:31.709 --> 00:02:33.310 there's another thing important in
NOTE Confidence: 0.9779065
00:02:33.310 --> 00:02:34.370 addition to brightness.
NOTE Confidence: 0.9995632
00:02:34.829 --> 00:02:36.049 That is the coherence.
NOTE Confidence: 0.9226781
00:02:36.785 --> 00:02:37.905 So we know that, you
NOTE Confidence: 0.9226781
00:02:37.905 --> 00:02:39.665 know, you know, laser, it
NOTE Confidence: 0.9226781
00:02:39.665 --> 00:02:41.105 is coherent, where there's a
NOTE Confidence: 0.9226781
00:02:41.105 --> 00:02:42.644 LED or lamp is incoherent.
NOTE Confidence: 0.93706197
00:02:43.264 --> 00:02:45.025 And this coherence actually here
NOTE Confidence: 0.93706197
00:02:45.025 --> 00:02:46.864 is really hurting us because
NOTE Confidence: 0.93706197
00:02:46.864 --> 00:02:48.644 that actually can introduce incoherent
NOTE Confidence: 0.93706197

00:02:48.785 --> 00:02:50.144 artifact, which I'm gonna show

NOTE Confidence: 0.93706197

00:02:50.144 --> 00:02:51.620 you in particular like a

NOTE Confidence: 0.93706197

00:02:51.620 --> 00:02:53.300 speckle noise. Maybe some of

NOTE Confidence: 0.93706197

00:02:53.300 --> 00:02:54.760 you have already seen that.

NOTE Confidence: 0.8542422

00:02:55.379 --> 00:02:57.220 So what we really ideal

NOTE Confidence: 0.8542422

00:02:57.220 --> 00:02:57.959 light source

NOTE Confidence: 0.9520542

00:02:58.260 --> 00:02:59.700 is to, you know, as

NOTE Confidence: 0.9520542

00:02:59.700 --> 00:03:00.900 bright as a laser, a

NOTE Confidence: 0.9520542

00:03:00.900 --> 00:03:01.720 standard laser,

NOTE Confidence: 0.9522238

00:03:02.180 --> 00:03:03.300 but it has a low

NOTE Confidence: 0.9522238

00:03:03.300 --> 00:03:04.739 coherence. So we don't have

NOTE Confidence: 0.9522238

00:03:04.739 --> 00:03:06.014 all this coherent artifact

NOTE Confidence: 0.82917726

00:03:06.415 --> 00:03:07.535 if we we try to

NOTE Confidence: 0.82917726

00:03:07.535 --> 00:03:08.755 use this as a illumination

NOTE Confidence: 0.9983472

00:03:09.294 --> 00:03:09.794 source.

NOTE Confidence: 0.95354694

00:03:10.495 --> 00:03:11.375 So we have been trying

NOTE Confidence: 0.95354694
00:03:11.375 --> 00:03:12.495 to study how we can
NOTE Confidence: 0.95354694
00:03:12.495 --> 00:03:13.775 find, you know, a light
NOTE Confidence: 0.95354694
00:03:13.775 --> 00:03:15.375 source that combine the advantage
NOTE Confidence: 0.95354694
00:03:15.375 --> 00:03:16.895 of a laser and also
NOTE Confidence: 0.95354694
00:03:16.895 --> 00:03:18.990 a lamp. Right? So that's
NOTE Confidence: 0.95354694
00:03:19.070 --> 00:03:20.190 actually we I got into
NOTE Confidence: 0.95354694
00:03:20.190 --> 00:03:21.410 this random laser,
NOTE Confidence: 0.841222
00:03:21.710 --> 00:03:23.470 which can really, produce a,
NOTE Confidence: 0.841222
00:03:23.470 --> 00:03:24.669 you know, a speckle free
NOTE Confidence: 0.841222
00:03:24.669 --> 00:03:25.169 image.
NOTE Confidence: 0.9273609
00:03:25.790 --> 00:03:27.550 So here shows example. You
NOTE Confidence: 0.9273609
00:03:27.550 --> 00:03:28.590 see this kind of a
NOTE Confidence: 0.9273609
00:03:28.590 --> 00:03:30.350 a speckled image. That's when
NOTE Confidence: 0.9273609
00:03:30.350 --> 00:03:31.544 we try to image a
NOTE Confidence: 0.9273609
00:03:31.705 --> 00:03:33.065 a sample, and then there's
NOTE Confidence: 0.9273609

00:03:33.065 --> 00:03:34.825 some scattering, you know, you

NOTE Confidence: 0.9273609

00:03:34.825 --> 00:03:36.185 know, layer in between the

NOTE Confidence: 0.9273609

00:03:36.185 --> 00:03:38.364 sample and the objective lens

NOTE Confidence: 0.9273609

00:03:38.425 --> 00:03:39.645 and also to the camera.

NOTE Confidence: 0.90860796

00:03:40.105 --> 00:03:41.245 We are using a laser

NOTE Confidence: 0.8687812

00:03:41.785 --> 00:03:43.084 as illumination.

NOTE Confidence: 0.9619495

00:03:43.720 --> 00:03:44.760 You see that we see

NOTE Confidence: 0.9619495

00:03:44.760 --> 00:03:45.880 all the speckle pattern. We

NOTE Confidence: 0.9619495

00:03:45.880 --> 00:03:47.160 don't see anything else. That's

NOTE Confidence: 0.9619495

00:03:47.160 --> 00:03:48.860 really a strong coherent artifact

NOTE Confidence: 0.9068744

00:03:49.400 --> 00:03:50.760 coming from this, you know,

NOTE Confidence: 0.9068744

00:03:50.760 --> 00:03:51.260 interference

NOTE Confidence: 0.92343885

00:03:51.880 --> 00:03:53.260 of this laser.

NOTE Confidence: 0.9376898

00:03:54.599 --> 00:03:56.120 So we actually develop a

NOTE Confidence: 0.9376898

00:03:56.120 --> 00:03:57.020 random laser

NOTE Confidence: 0.846432

00:03:57.395 --> 00:03:58.515 and that using that as

NOTE Confidence: 0.846432
00:03:58.515 --> 00:03:59.015 illumination,
NOTE Confidence: 0.90108776
00:03:59.475 --> 00:04:00.995 you see that actually, we
NOTE Confidence: 0.90108776
00:04:00.995 --> 00:04:02.195 can really even we have
NOTE Confidence: 0.90108776
00:04:02.195 --> 00:04:03.715 a strong scattering we have
NOTE Confidence: 0.90108776
00:04:03.715 --> 00:04:05.315 significant scattering here, we can
NOTE Confidence: 0.90108776
00:04:05.315 --> 00:04:06.595 still see this kind of
NOTE Confidence: 0.90108776
00:04:06.595 --> 00:04:07.095 features.
NOTE Confidence: 0.9785628
00:04:07.395 --> 00:04:08.515 And this kind of random
NOTE Confidence: 0.9785628
00:04:08.515 --> 00:04:09.875 laser can be as bright
NOTE Confidence: 0.9785628
00:04:09.875 --> 00:04:10.775 as a conventional
NOTE Confidence: 0.9632656
00:04:11.439 --> 00:04:12.879 laser. So that is really,
NOTE Confidence: 0.9632656
00:04:13.040 --> 00:04:14.400 give us a more powerful
NOTE Confidence: 0.9632656
00:04:14.400 --> 00:04:16.580 source for speckle free imaging,
NOTE Confidence: 0.963863
00:04:16.880 --> 00:04:18.500 especially for full field imaging.
NOTE Confidence: 0.92704314
00:04:19.600 --> 00:04:20.639 So that is what I
NOTE Confidence: 0.92704314

00:04:20.639 --> 00:04:21.759 did the first part, try
NOTE Confidence: 0.92704314

00:04:21.759 --> 00:04:22.900 to get rid of speckle.
NOTE Confidence: 0.9350934

00:04:23.375 --> 00:04:24.574 But it turns out speckle
NOTE Confidence: 0.9350934

00:04:24.574 --> 00:04:26.175 is not always bad. Because
NOTE Confidence: 0.9350934

00:04:26.175 --> 00:04:27.294 even though they cannot take
NOTE Confidence: 0.9350934

00:04:27.294 --> 00:04:28.495 a allow us to see
NOTE Confidence: 0.9350934

00:04:28.495 --> 00:04:30.095 the structure, they can allow
NOTE Confidence: 0.9350934

00:04:30.095 --> 00:04:31.055 allow us to see the
NOTE Confidence: 0.9350934

00:04:31.055 --> 00:04:31.555 motion.
NOTE Confidence: 0.90488726

00:04:32.175 --> 00:04:33.294 Because if you see, for
NOTE Confidence: 0.90488726

00:04:33.294 --> 00:04:34.654 example, if there's something was
NOTE Confidence: 0.90488726

00:04:34.654 --> 00:04:36.014 moving when they generate speckle
NOTE Confidence: 0.90488726

00:04:36.014 --> 00:04:37.375 pattern, the speckle pattern will
NOTE Confidence: 0.90488726

00:04:37.375 --> 00:04:37.875 change.
NOTE Confidence: 0.94657755

00:04:38.190 --> 00:04:39.230 If you integrate over a
NOTE Confidence: 0.94657755

00:04:39.230 --> 00:04:41.150 certain time, the speckle pattern

NOTE Confidence: 0.94657755

00:04:41.150 --> 00:04:42.590 will average out so you

NOTE Confidence: 0.94657755

00:04:42.590 --> 00:04:43.650 have a low contrast.

NOTE Confidence: 0.9898837

00:04:44.270 --> 00:04:45.870 So speckle contrast tell us

NOTE Confidence: 0.9898837

00:04:45.870 --> 00:04:46.529 the motion.

NOTE Confidence: 0.97899884

00:04:47.230 --> 00:04:48.590 So what would be ideal

NOTE Confidence: 0.97899884

00:04:48.590 --> 00:04:49.470 is that if we can

NOTE Confidence: 0.97899884

00:04:49.470 --> 00:04:51.145 switch the laser source, the

NOTE Confidence: 0.97899884

00:04:51.145 --> 00:04:51.645 coherence,

NOTE Confidence: 0.97822773

00:04:51.945 --> 00:04:53.145 I can first get into

NOTE Confidence: 0.97822773

00:04:53.145 --> 00:04:54.665 low spatial coherence. I can

NOTE Confidence: 0.97822773

00:04:54.665 --> 00:04:55.485 see the structure.

NOTE Confidence: 0.94661033

00:04:56.025 --> 00:04:57.065 Then I can switch to

NOTE Confidence: 0.94661033

00:04:57.065 --> 00:04:58.505 high spatial coherence. I can

NOTE Confidence: 0.94661033

00:04:58.505 --> 00:04:59.705 see the speckle and how

NOTE Confidence: 0.94661033

00:04:59.705 --> 00:05:01.245 they're moving, how they're changing.

NOTE Confidence: 0.94661033

00:05:01.385 --> 00:05:02.264 Then I can see the
NOTE Confidence: 0.94661033

00:05:02.264 --> 00:05:02.764 flow.
NOTE Confidence: 0.88009363

00:05:03.190 --> 00:05:04.730 So here shows one example,
NOTE Confidence: 0.88009363

00:05:05.029 --> 00:05:06.310 which I I should collaborate
NOTE Confidence: 0.88009363

00:05:06.310 --> 00:05:08.389 with professor, Michael Choma and
NOTE Confidence: 0.88009363

00:05:08.389 --> 00:05:08.889 Mustafa
NOTE Confidence: 0.87788594

00:05:09.510 --> 00:05:11.110 Koha here at the medical
NOTE Confidence: 0.87788594

00:05:11.110 --> 00:05:12.470 school. We try to imaging
NOTE Confidence: 0.87788594

00:05:12.470 --> 00:05:13.589 the, you know, this, you
NOTE Confidence: 0.87788594

00:05:13.589 --> 00:05:14.410 know, heartbeat
NOTE Confidence: 0.83628845

00:05:14.950 --> 00:05:16.490 of a a leading tadpole.
NOTE Confidence: 0.9528078

00:05:17.315 --> 00:05:18.435 So for this kind of
NOTE Confidence: 0.9528078

00:05:18.435 --> 00:05:19.955 tadpole here, so what we
NOTE Confidence: 0.9528078

00:05:19.955 --> 00:05:20.995 want, we want to see
NOTE Confidence: 0.9528078

00:05:20.995 --> 00:05:22.275 how this, you know, the
NOTE Confidence: 0.9528078

00:05:22.354 --> 00:05:24.435 this heartbeat, what can happen

NOTE Confidence: 0.9528078
00:05:24.435 --> 00:05:25.255 to the structure.
NOTE Confidence: 0.9701531
00:05:25.635 --> 00:05:26.595 We also want to see
NOTE Confidence: 0.9701531
00:05:26.595 --> 00:05:27.574 what is the flow
NOTE Confidence: 0.8541409
00:05:28.115 --> 00:05:29.335 because this is the animal
NOTE Confidence: 0.8541409
00:05:29.395 --> 00:05:31.014 mode of heart disease.
NOTE Confidence: 0.8686498
00:05:31.779 --> 00:05:33.380 So here, this basically show
NOTE Confidence: 0.8686498
00:05:33.380 --> 00:05:34.580 that we develop a laser.
NOTE Confidence: 0.8686498
00:05:34.580 --> 00:05:35.779 We can switch very quickly
NOTE Confidence: 0.8686498
00:05:35.779 --> 00:05:37.139 the spatial coherence back and
NOTE Confidence: 0.8686498
00:05:37.139 --> 00:05:37.639 forth.
NOTE Confidence: 0.93470347
00:05:38.020 --> 00:05:39.240 So if I can,
NOTE Confidence: 0.7953955
00:05:40.500 --> 00:05:42.040 oh, why I cannot,
NOTE Confidence: 0.9990659
00:05:42.740 --> 00:05:43.560 play the
NOTE Confidence: 0.88254035
00:05:44.180 --> 00:05:45.300 can somebody help me to
NOTE Confidence: 0.88254035
00:05:45.300 --> 00:05:47.080 play the video or
NOTE Confidence: 0.9673199

00:05:47.915 --> 00:05:48.795 I have to play this
NOTE Confidence: 0.9673199

00:05:48.955 --> 00:05:50.075 okay. Anyway, this video is
NOTE Confidence: 0.9673199

00:05:50.075 --> 00:05:50.735 not working.
NOTE Confidence: 0.8094606

00:05:52.875 --> 00:05:54.154 I get okay. No. I
NOTE Confidence: 0.8094606

00:05:54.154 --> 00:05:55.195 think okay. Let me try
NOTE Confidence: 0.8094606

00:05:55.195 --> 00:05:55.835 to see what I can
NOTE Confidence: 0.8094606

00:05:55.835 --> 00:05:56.795 just use in this thing
NOTE Confidence: 0.8094606

00:05:56.795 --> 00:05:57.535 here too.
NOTE Confidence: 0.85658556

00:05:57.995 --> 00:05:59.455 Right. Okay. Folder.
NOTE Confidence: 0.7421036

00:06:00.795 --> 00:06:01.295 Oh,
NOTE Confidence: 0.9557374

00:06:03.150 --> 00:06:03.970 okay. So
NOTE Confidence: 0.99334997

00:06:05.789 --> 00:06:06.690 okay. Anyway
NOTE Confidence: 0.9954679

00:06:07.870 --> 00:06:08.370 so
NOTE Confidence: 0.9239204

00:06:08.750 --> 00:06:10.430 the unit the the this
NOTE Confidence: 0.9239204

00:06:10.430 --> 00:06:11.490 thing is not playing.
NOTE Confidence: 0.9014131

00:06:12.830 --> 00:06:14.529 I have a unit here.

NOTE Confidence: 0.79392374
00:06:20.835 --> 00:06:21.714 Oh, somehow, I think this
NOTE Confidence: 0.79392374
00:06:21.875 --> 00:06:22.754 cannot play. I don't think
NOTE Confidence: 0.79392374
00:06:22.754 --> 00:06:25.094 it's gone. Okay. Anyway, so
NOTE Confidence: 0.79392374
00:06:25.314 --> 00:06:26.594 that's fine. I think it's
NOTE Confidence: 0.79392374
00:06:26.594 --> 00:06:27.254 the same.
NOTE Confidence: 0.7991963
00:06:28.354 --> 00:06:29.814 No problem. Okay.
NOTE Confidence: 0.9918225
00:06:30.275 --> 00:06:30.775 Yeah.
NOTE Confidence: 0.87355
00:06:32.130 --> 00:06:33.170 Yeah. I see maybe when
NOTE Confidence: 0.87355
00:06:33.170 --> 00:06:33.490 we,
NOTE Confidence: 0.8969107
00:06:34.210 --> 00:06:35.890 translate this file, there's some
NOTE Confidence: 0.8969107
00:06:35.890 --> 00:06:37.170 issue there. So, anyway, you're
NOTE Confidence: 0.8969107
00:06:37.170 --> 00:06:38.450 supposed to see this heart
NOTE Confidence: 0.8969107
00:06:38.450 --> 00:06:40.050 is beating. As I can
NOTE Confidence: 0.8969107
00:06:40.050 --> 00:06:41.250 see, there's a flow of
NOTE Confidence: 0.8969107
00:06:41.250 --> 00:06:42.690 the blood from one chamber
NOTE Confidence: 0.8969107

00:06:42.690 --> 00:06:44.310 to another chamber simultaneously.

NOTE Confidence: 0.8804886

00:06:44.690 --> 00:06:45.730 So this allows to see

NOTE Confidence: 0.8804886

00:06:45.730 --> 00:06:47.090 simultaneously the structure,

NOTE Confidence: 0.9468358

00:06:47.865 --> 00:06:49.225 change and also there's a

NOTE Confidence: 0.9468358

00:06:49.225 --> 00:06:51.145 shape change there. So this

NOTE Confidence: 0.9468358

00:06:51.145 --> 00:06:51.725 is basically,

NOTE Confidence: 0.9579096

00:06:52.105 --> 00:06:53.305 allow, you know, them to

NOTE Confidence: 0.9579096

00:06:53.305 --> 00:06:54.665 really study what is this,

NOTE Confidence: 0.9579096

00:06:54.904 --> 00:06:55.945 you know, if there's some

NOTE Confidence: 0.9579096

00:06:55.945 --> 00:06:57.464 disease there, what happens to

NOTE Confidence: 0.9579096

00:06:57.464 --> 00:06:59.145 the deformation and what, I

NOTE Confidence: 0.9579096

00:06:59.145 --> 00:07:00.265 mean, what happened to the

NOTE Confidence: 0.9579096

00:07:00.265 --> 00:07:01.900 flow of blood. Because the

NOTE Confidence: 0.9579096

00:07:01.900 --> 00:07:03.500 contrast shown as the yellow

NOTE Confidence: 0.9579096

00:07:03.500 --> 00:07:04.460 here tells you how much

NOTE Confidence: 0.9579096

00:07:04.460 --> 00:07:05.839 blood in each location.

NOTE Confidence: 0.9592086

00:07:07.020 --> 00:07:08.300 You can say, well, maybe

NOTE Confidence: 0.9592086

00:07:08.300 --> 00:07:09.020 I can also do this

NOTE Confidence: 0.9592086

00:07:09.020 --> 00:07:10.220 with ultrasound. Why you want

NOTE Confidence: 0.9592086

00:07:10.220 --> 00:07:11.100 to do this with, you

NOTE Confidence: 0.9592086

00:07:11.100 --> 00:07:12.540 know, light? Because light can

NOTE Confidence: 0.9592086

00:07:12.540 --> 00:07:14.060 give us much better spatial

NOTE Confidence: 0.9592086

00:07:14.060 --> 00:07:14.560 resolution.

NOTE Confidence: 0.94677305

00:07:15.245 --> 00:07:16.445 So, you know, for some

NOTE Confidence: 0.94677305

00:07:16.445 --> 00:07:17.985 application, this could be useful.

NOTE Confidence: 0.879367

00:07:19.965 --> 00:07:21.485 Alright. So that is the

NOTE Confidence: 0.879367

00:07:21.485 --> 00:07:22.685 first part we developed given

NOTE Confidence: 0.879367

00:07:22.685 --> 00:07:23.805 a light source. We tune

NOTE Confidence: 0.879367

00:07:23.805 --> 00:07:25.425 the coherence with different applications

NOTE Confidence: 0.8099973

00:07:25.805 --> 00:07:27.085 because the reason I have

NOTE Confidence: 0.8099973

00:07:27.085 --> 00:07:28.445 to say I really, enjoy

NOTE Confidence: 0.8099973

00:07:28.445 --> 00:07:29.665 collaboration with Michael,
NOTE Confidence: 0.9201801

00:07:30.125 --> 00:07:31.380 the most offer because they
NOTE Confidence: 0.9201801

00:07:31.380 --> 00:07:32.500 really tell me what they
NOTE Confidence: 0.9201801

00:07:32.500 --> 00:07:33.540 need, what kind of light
NOTE Confidence: 0.9201801

00:07:33.540 --> 00:07:34.900 source they need, and then
NOTE Confidence: 0.9201801

00:07:34.900 --> 00:07:36.020 this will help me to
NOTE Confidence: 0.9201801

00:07:36.020 --> 00:07:37.300 really develop this kind of
NOTE Confidence: 0.9201801

00:07:37.300 --> 00:07:38.520 light source for the application.
NOTE Confidence: 0.9543129

00:07:39.060 --> 00:07:40.020 So this is very important
NOTE Confidence: 0.9543129

00:07:40.020 --> 00:07:41.300 for engineer because we have
NOTE Confidence: 0.9543129

00:07:41.300 --> 00:07:42.180 tools, but we don't know
NOTE Confidence: 0.9543129

00:07:42.180 --> 00:07:43.220 what this can be useful
NOTE Confidence: 0.9543129

00:07:43.220 --> 00:07:44.040 for. Right?
NOTE Confidence: 0.9290707

00:07:44.745 --> 00:07:45.705 So that is the first
NOTE Confidence: 0.9290707

00:07:45.705 --> 00:07:46.745 part. And now the second
NOTE Confidence: 0.9290707

00:07:46.745 --> 00:07:49.165 part is that, we also

NOTE Confidence: 0.9290707
00:07:49.385 --> 00:07:50.605 try to do some computational
NOTE Confidence: 0.9290707
00:07:50.665 --> 00:07:51.165 imaging.
NOTE Confidence: 0.9413641
00:07:51.625 --> 00:07:52.825 Meaning that, you know, we
NOTE Confidence: 0.9413641
00:07:52.825 --> 00:07:54.365 try to do structure illumination.
NOTE Confidence: 0.9650156
00:07:54.985 --> 00:07:56.265 We try to illuminate, you
NOTE Confidence: 0.9650156
00:07:56.265 --> 00:07:57.385 know, the sample with some
NOTE Confidence: 0.9650156
00:07:57.385 --> 00:07:59.145 particular patterns so that, for
NOTE Confidence: 0.9650156
00:07:59.145 --> 00:08:00.480 example, can give us some
NOTE Confidence: 0.9650156
00:08:00.560 --> 00:08:02.000 better resolution or give us
NOTE Confidence: 0.9650156
00:08:02.000 --> 00:08:03.520 some, you know, additional feature
NOTE Confidence: 0.9650156
00:08:03.520 --> 00:08:04.320 which we can now do
NOTE Confidence: 0.9650156
00:08:04.320 --> 00:08:05.700 for homogeneous illumination.
NOTE Confidence: 0.91665727
00:08:06.560 --> 00:08:08.000 So for this, we actually
NOTE Confidence: 0.91665727
00:08:08.000 --> 00:08:09.840 are using speckle pattern because,
NOTE Confidence: 0.91665727
00:08:10.000 --> 00:08:11.760 you know, compared to periodic
NOTE Confidence: 0.91665727

00:08:11.760 --> 00:08:13.280 structure people use for this
NOTE Confidence: 0.91665727

00:08:13.280 --> 00:08:14.585 kind of structure illumination,
NOTE Confidence: 0.98007166

00:08:15.205 --> 00:08:16.965 actually, speckle pattern has some
NOTE Confidence: 0.98007166

00:08:16.965 --> 00:08:17.865 additional advantage.
NOTE Confidence: 0.99680996

00:08:18.485 --> 00:08:19.145 For example,
NOTE Confidence: 0.9843335

00:08:19.525 --> 00:08:20.025 vertical,
NOTE Confidence: 0.90501463

00:08:20.485 --> 00:08:21.305 axial sectioning.
NOTE Confidence: 0.9660885

00:08:21.845 --> 00:08:22.805 I will not get into
NOTE Confidence: 0.9660885

00:08:22.805 --> 00:08:24.565 those detail, but what we
NOTE Confidence: 0.9660885

00:08:24.565 --> 00:08:25.925 did is that we actually
NOTE Confidence: 0.9660885

00:08:25.925 --> 00:08:27.900 can design the speckle pattern,
NOTE Confidence: 0.9660885

00:08:28.040 --> 00:08:29.639 not just using, like, a
NOTE Confidence: 0.9660885

00:08:29.639 --> 00:08:31.020 a a common speckle pattern.
NOTE Confidence: 0.9660885

00:08:31.160 --> 00:08:32.679 We can design the speckle
NOTE Confidence: 0.9660885

00:08:32.679 --> 00:08:34.600 pattern for particular, you know,
NOTE Confidence: 0.9660885

00:08:34.600 --> 00:08:35.100 application,

NOTE Confidence: 0.90173745

00:08:35.559 --> 00:08:36.600 and then we can really,

NOTE Confidence: 0.90173745

00:08:37.000 --> 00:08:38.200 use that to enhance the

NOTE Confidence: 0.90173745

00:08:38.200 --> 00:08:39.260 imaging performance.

NOTE Confidence: 0.7930636

00:08:40.145 --> 00:08:41.905 So this, again, we actually

NOTE Confidence: 0.7930636

00:08:41.905 --> 00:08:44.245 collaborate with, professor Jorga Viverstov

NOTE Confidence: 0.7930636

00:08:44.385 --> 00:08:46.005 here at your medical school

NOTE Confidence: 0.7930636

00:08:46.145 --> 00:08:48.065 to using this, design spec

NOTE Confidence: 0.7930636

00:08:48.065 --> 00:08:48.565 pattern

NOTE Confidence: 0.956511

00:08:48.945 --> 00:08:51.525 for parallelized nonlinear pattern illumination

NOTE Confidence: 0.956511

00:08:51.825 --> 00:08:52.325 microscopy.

NOTE Confidence: 0.9128698

00:08:52.865 --> 00:08:54.325 This is based on fluorescence

NOTE Confidence: 0.9128698

00:08:54.625 --> 00:08:55.605 photo switching.

NOTE Confidence: 0.9530145

00:08:56.730 --> 00:08:58.010 So just show you a

NOTE Confidence: 0.9530145

00:08:58.010 --> 00:08:59.850 simple example here. So what

NOTE Confidence: 0.9530145

00:08:59.850 --> 00:09:01.070 we did is, for example,

NOTE Confidence: 0.9120826

00:09:01.450 --> 00:09:02.650 outside of this region, this
NOTE Confidence: 0.9120826

00:09:02.650 --> 00:09:03.690 is just a I mean,
NOTE Confidence: 0.9120826

00:09:03.690 --> 00:09:05.690 illustration with a standard speckle
NOTE Confidence: 0.9120826

00:09:05.690 --> 00:09:07.870 pattern people use. And in
NOTE Confidence: 0.9120826

00:09:08.010 --> 00:09:09.450 the central box here, it
NOTE Confidence: 0.9120826

00:09:09.450 --> 00:09:10.890 is a particular speckle pattern
NOTE Confidence: 0.9120826

00:09:10.890 --> 00:09:11.630 we designed.
NOTE Confidence: 0.9503234

00:09:12.245 --> 00:09:14.085 And then, if we're using
NOTE Confidence: 0.9503234

00:09:14.085 --> 00:09:15.925 this to illuminate this, you
NOTE Confidence: 0.9503234

00:09:15.925 --> 00:09:16.665 know, protein,
NOTE Confidence: 0.9458413

00:09:17.045 --> 00:09:18.165 and then for the bright
NOTE Confidence: 0.9458413

00:09:18.165 --> 00:09:20.184 regime, the protein will switch.
NOTE Confidence: 0.9458413

00:09:20.404 --> 00:09:21.525 And in the dark regime,
NOTE Confidence: 0.9458413

00:09:21.525 --> 00:09:22.485 they will not switch, so
NOTE Confidence: 0.9458413

00:09:22.485 --> 00:09:23.925 they can still fluorescent when
NOTE Confidence: 0.9458413

00:09:23.925 --> 00:09:24.904 we excite them.

NOTE Confidence: 0.91936994
00:09:25.309 --> 00:09:26.269 So now you can see
NOTE Confidence: 0.91936994
00:09:26.269 --> 00:09:28.110 the fluorescence here. Now you
NOTE Confidence: 0.91936994
00:09:28.110 --> 00:09:29.410 can see a very different
NOTE Confidence: 0.91936994
00:09:29.470 --> 00:09:30.850 things here. You know, outside
NOTE Confidence: 0.91936994
00:09:30.990 --> 00:09:31.889 using standard
NOTE Confidence: 0.8742509
00:09:32.350 --> 00:09:33.649 speckle, illumination,
NOTE Confidence: 0.9704593
00:09:34.110 --> 00:09:35.070 you can see this kind
NOTE Confidence: 0.9704593
00:09:35.070 --> 00:09:36.589 of, you know, like, this
NOTE Confidence: 0.9704593
00:09:36.589 --> 00:09:37.070 kind of,
NOTE Confidence: 0.9640702
00:09:38.434 --> 00:09:40.135 elongated or this kind of
NOTE Confidence: 0.9640702
00:09:40.355 --> 00:09:42.355 a network of fluorescence, you
NOTE Confidence: 0.9640702
00:09:42.355 --> 00:09:44.195 know, from the sample, which
NOTE Confidence: 0.9640702
00:09:44.195 --> 00:09:45.235 is hard to tell what's
NOTE Confidence: 0.9640702
00:09:45.235 --> 00:09:47.075 going on. But inside here,
NOTE Confidence: 0.9640702
00:09:47.075 --> 00:09:48.434 you see the fluorescence coming
NOTE Confidence: 0.9640702

00:09:48.434 --> 00:09:49.495 from isolated
NOTE Confidence: 0.9271018

00:09:50.195 --> 00:09:51.875 individual, you know, bright, you
NOTE Confidence: 0.9271018

00:09:51.875 --> 00:09:53.520 know, I mean, region there.
NOTE Confidence: 0.9271018

00:09:53.679 --> 00:09:54.880 So this actually coming from
NOTE Confidence: 0.9271018

00:09:54.880 --> 00:09:56.240 those dark region which we
NOTE Confidence: 0.9271018

00:09:56.240 --> 00:09:57.360 design in this kind of
NOTE Confidence: 0.9271018

00:09:57.360 --> 00:09:59.360 speckle pattern, and this actually
NOTE Confidence: 0.9271018

00:09:59.360 --> 00:10:00.320 can give us a better
NOTE Confidence: 0.9271018

00:10:00.320 --> 00:10:00.820 resolution.
NOTE Confidence: 0.94792217

00:10:01.280 --> 00:10:02.800 So we actually show that,
NOTE Confidence: 0.94792217

00:10:03.040 --> 00:10:04.240 we can break the optical
NOTE Confidence: 0.94792217

00:10:04.240 --> 00:10:06.320 diffraction limit three times, which
NOTE Confidence: 0.94792217

00:10:06.320 --> 00:10:07.440 allow us get a three
NOTE Confidence: 0.94792217

00:10:07.440 --> 00:10:08.260 times better
NOTE Confidence: 0.74859816

00:10:08.595 --> 00:10:09.095 spatial
NOTE Confidence: 0.9985156

00:10:09.795 --> 00:10:10.295 resolution.

NOTE Confidence: 0.88748217

00:10:10.995 --> 00:10:12.274 So this is basically to

NOTE Confidence: 0.88748217

00:10:12.355 --> 00:10:13.235 you know, we are actually

NOTE Confidence: 0.88748217

00:10:13.235 --> 00:10:14.595 continue this design in the

NOTE Confidence: 0.88748217

00:10:14.595 --> 00:10:16.615 speckle pattern for particular applications

NOTE Confidence: 0.9454602

00:10:17.074 --> 00:10:18.434 so that, you know, to

NOTE Confidence: 0.9454602

00:10:18.434 --> 00:10:19.635 optimize so that we can

NOTE Confidence: 0.9454602

00:10:19.635 --> 00:10:21.154 combine with the, you know,

NOTE Confidence: 0.9454602

00:10:21.635 --> 00:10:22.135 reconstruction

NOTE Confidence: 0.967634

00:10:22.514 --> 00:10:24.780 algorithm, which people have developed

NOTE Confidence: 0.967634

00:10:25.000 --> 00:10:26.220 so that we can simultaneously

NOTE Confidence: 0.9640929

00:10:26.600 --> 00:10:28.780 optimize hardware, which is illumination,

NOTE Confidence: 0.97335964

00:10:29.240 --> 00:10:30.520 and the software, which is

NOTE Confidence: 0.97335964

00:10:30.520 --> 00:10:32.360 this algorithm to reconstruct the

NOTE Confidence: 0.97335964

00:10:32.360 --> 00:10:32.860 information.

NOTE Confidence: 0.957171

00:10:33.800 --> 00:10:34.760 So, again, we would like

NOTE Confidence: 0.957171

00:10:34.760 --> 00:10:36.220 to see what potential application
NOTE Confidence: 0.957171

00:10:36.280 --> 00:10:37.100 this could be,
NOTE Confidence: 0.98142976

00:10:37.559 --> 00:10:38.700 for medical application.
NOTE Confidence: 0.99987185

00:10:39.615 --> 00:10:40.115 So
NOTE Confidence: 0.95170414

00:10:40.495 --> 00:10:42.575 the next one, which we
NOTE Confidence: 0.95170414

00:10:42.575 --> 00:10:44.735 have been studying is, actually,
NOTE Confidence: 0.95170414

00:10:44.735 --> 00:10:45.775 this is a a deep
NOTE Confidence: 0.95170414

00:10:45.775 --> 00:10:46.675 tissue imaging.
NOTE Confidence: 0.9557118

00:10:47.215 --> 00:10:49.054 Like, John just mentioned, we
NOTE Confidence: 0.9557118

00:10:49.054 --> 00:10:50.915 actually recently got, also,
NOTE Confidence: 0.84074986

00:10:51.639 --> 00:10:53.000 a phase two grant from
NOTE Confidence: 0.84074986

00:10:53.000 --> 00:10:54.699 this Charles Zuckerberg initiative
NOTE Confidence: 0.9819155

00:10:55.079 --> 00:10:56.380 on deep tissue imaging.
NOTE Confidence: 0.99207616

00:10:56.920 --> 00:10:58.839 And, so our goal is
NOTE Confidence: 0.99207616

00:10:58.839 --> 00:11:00.540 try to utilize the correlation
NOTE Confidence: 0.99207616

00:11:00.760 --> 00:11:01.260 engineering

NOTE Confidence: 0.9054997
00:11:01.800 --> 00:11:03.559 to achieve deep multi photon
NOTE Confidence: 0.9054997
00:11:03.559 --> 00:11:04.059 microscopy.
NOTE Confidence: 0.9773767
00:11:05.105 --> 00:11:05.505 And,
NOTE Confidence: 0.9404782
00:11:05.985 --> 00:11:08.245 our, again, our, you know,
NOTE Confidence: 0.9503482
00:11:08.625 --> 00:11:09.764 you know, approach
NOTE Confidence: 0.94327915
00:11:10.065 --> 00:11:11.505 is, again, on the light
NOTE Confidence: 0.94327915
00:11:11.505 --> 00:11:12.865 source because light source is
NOTE Confidence: 0.94327915
00:11:12.865 --> 00:11:14.225 really the engine for optical
NOTE Confidence: 0.94327915
00:11:14.225 --> 00:11:14.725 microscopy.
NOTE Confidence: 0.92970854
00:11:15.105 --> 00:11:16.065 If you see the last,
NOTE Confidence: 0.92970854
00:11:16.065 --> 00:11:17.345 I don't know, twenty, thirty
NOTE Confidence: 0.92970854
00:11:17.345 --> 00:11:18.840 years, all there's a breakthrough
NOTE Confidence: 0.92970854
00:11:18.840 --> 00:11:20.679 in optical, you know, imaging
NOTE Confidence: 0.92970854
00:11:20.679 --> 00:11:21.580 is coming from
NOTE Confidence: 0.8881398
00:11:22.040 --> 00:11:22.920 the drum or the light
NOTE Confidence: 0.8881398

00:11:22.920 --> 00:11:24.520 source, ultra short, you know,
NOTE Confidence: 0.8881398

00:11:24.520 --> 00:11:26.360 pulses and other things. So
NOTE Confidence: 0.8881398

00:11:26.360 --> 00:11:27.320 we want to build a
NOTE Confidence: 0.8881398

00:11:27.320 --> 00:11:28.760 next generation of the laser
NOTE Confidence: 0.8881398

00:11:28.760 --> 00:11:30.760 source for better, deeper, and
NOTE Confidence: 0.8881398

00:11:30.760 --> 00:11:31.820 a gentle microscopy.
NOTE Confidence: 0.99685156

00:11:32.975 --> 00:11:34.095 So for this one here,
NOTE Confidence: 0.99685156

00:11:34.095 --> 00:11:35.635 we actually have a team.
NOTE Confidence: 0.8719156

00:11:36.255 --> 00:11:37.615 We actually have a a
NOTE Confidence: 0.8719156

00:11:37.615 --> 00:11:38.115 collaborations
NOTE Confidence: 0.83367574

00:11:38.655 --> 00:11:40.095 from professor Tian Yu Wang
NOTE Confidence: 0.83367574

00:11:40.095 --> 00:11:42.335 from Boston University and and
NOTE Confidence: 0.83367574

00:11:42.335 --> 00:11:44.755 also professor from Cornell University
NOTE Confidence: 0.91985965

00:11:45.149 --> 00:11:46.110 who really is a, you
NOTE Confidence: 0.91985965

00:11:46.110 --> 00:11:47.629 know, world leader on, you
NOTE Confidence: 0.91985965

00:11:47.629 --> 00:11:48.990 know, not two photon, three

NOTE Confidence: 0.91985965

00:11:48.990 --> 00:11:49.970 photon microscopy.

NOTE Confidence: 0.93314284

00:11:50.670 --> 00:11:51.949 And, also, we are fortunate

NOTE Confidence: 0.93314284

00:11:51.949 --> 00:11:52.269 to have,

NOTE Confidence: 0.8134301

00:11:52.990 --> 00:11:54.269 Logan Wright, who's a young

NOTE Confidence: 0.8134301

00:11:54.269 --> 00:11:56.190 assistant professor, join Yale applied

NOTE Confidence: 0.8134301

00:11:56.190 --> 00:11:57.089 physics department,

NOTE Confidence: 0.92768836

00:11:57.790 --> 00:11:59.629 working together to develop this

NOTE Confidence: 0.92768836

00:11:59.629 --> 00:12:01.035 kind of light source. So

NOTE Confidence: 0.92768836

00:12:01.035 --> 00:12:02.475 we are engineers and those

NOTE Confidence: 0.92768836

00:12:02.554 --> 00:12:03.675 you know? So,

NOTE Confidence: 0.9838115

00:12:04.154 --> 00:12:05.595 what particularly we want to

NOTE Confidence: 0.9838115

00:12:05.595 --> 00:12:06.875 do, I will not get

NOTE Confidence: 0.9838115

00:12:06.875 --> 00:12:08.014 into much detail,

NOTE Confidence: 0.93683046

00:12:08.315 --> 00:12:09.675 is that what we want

NOTE Confidence: 0.93683046

00:12:09.675 --> 00:12:11.855 to is really, to precisely

NOTE Confidence: 0.93683046

00:12:12.075 --> 00:12:14.255 tailor the coherent multimodal laser
NOTE Confidence: 0.93683046

00:12:14.475 --> 00:12:15.695 so that we can maximize
NOTE Confidence: 0.93683046

00:12:15.755 --> 00:12:17.830 the multi photon absorption efficiency,
NOTE Confidence: 0.9833194

00:12:18.690 --> 00:12:20.950 in this complex fluorescent molecules.
NOTE Confidence: 0.94244075

00:12:21.490 --> 00:12:22.530 So, basically, we want to
NOTE Confidence: 0.94244075

00:12:22.530 --> 00:12:23.970 say what kind of fluorescent
NOTE Confidence: 0.94244075

00:12:23.970 --> 00:12:25.510 molecules we want to target,
NOTE Confidence: 0.94244075

00:12:25.809 --> 00:12:26.850 and so we want to
NOTE Confidence: 0.94244075

00:12:26.850 --> 00:12:28.130 see how we can maximize
NOTE Confidence: 0.94244075

00:12:28.130 --> 00:12:29.670 this multi photon absorption
NOTE Confidence: 0.96365166

00:12:30.050 --> 00:12:32.390 by tailoring this illumination source.
NOTE Confidence: 0.96365166

00:12:32.665 --> 00:12:33.785 Okay? So in some way,
NOTE Confidence: 0.96365166

00:12:33.785 --> 00:12:34.825 we want to co design
NOTE Confidence: 0.96365166

00:12:34.825 --> 00:12:36.184 the light source also with
NOTE Confidence: 0.96365166

00:12:36.184 --> 00:12:37.625 the molecule so that we
NOTE Confidence: 0.96365166

00:12:37.625 --> 00:12:38.745 can enhance this kind of

NOTE Confidence: 0.96365166
00:12:38.745 --> 00:12:39.485 three photon,
NOTE Confidence: 0.9974345
00:12:40.025 --> 00:12:40.525 microscopy
NOTE Confidence: 0.88770306
00:12:40.905 --> 00:12:42.184 that is mostly for the
NOTE Confidence: 0.88770306
00:12:42.184 --> 00:12:43.705 tissue imaging, like go to
NOTE Confidence: 0.88770306
00:12:43.705 --> 00:12:44.765 the brain imaging.
NOTE Confidence: 0.9937489
00:12:46.429 --> 00:12:46.929 So,
NOTE Confidence: 0.9159337
00:12:47.309 --> 00:12:48.670 this is, like, a overview
NOTE Confidence: 0.9159337
00:12:48.670 --> 00:12:50.030 what we have been what
NOTE Confidence: 0.9159337
00:12:50.030 --> 00:12:51.390 I've been doing so far.
NOTE Confidence: 0.9159337
00:12:51.390 --> 00:12:52.270 And also, I will now
NOTE Confidence: 0.9159337
00:12:52.350 --> 00:12:53.150 I want to go to
NOTE Confidence: 0.9159337
00:12:53.150 --> 00:12:55.170 this, you know, wavefront shaping.
NOTE Confidence: 0.9159337
00:12:55.230 --> 00:12:56.510 So this is another technique
NOTE Confidence: 0.9159337
00:12:56.510 --> 00:12:57.630 I wish to introduce to
NOTE Confidence: 0.9159337
00:12:57.630 --> 00:12:59.150 you, to see whether that
NOTE Confidence: 0.9159337

00:12:59.150 --> 00:13:00.590 could be applied for immune
NOTE Confidence: 0.9159337

00:13:00.590 --> 00:13:01.090 system.
NOTE Confidence: 0.9994773

00:13:01.775 --> 00:13:02.275 So
NOTE Confidence: 0.91992146

00:13:02.975 --> 00:13:04.515 we know that, you usually,
NOTE Confidence: 0.91992146

00:13:04.655 --> 00:13:05.775 you know, why we cannot
NOTE Confidence: 0.91992146

00:13:05.775 --> 00:13:06.995 see deep into a tissue?
NOTE Confidence: 0.91992146

00:13:07.055 --> 00:13:08.434 Because of the light scattering,
NOTE Confidence: 0.91992146

00:13:08.495 --> 00:13:09.635 not because the absorption.
NOTE Confidence: 0.96692467

00:13:10.175 --> 00:13:11.135 So you can see this
NOTE Confidence: 0.96692467

00:13:11.135 --> 00:13:12.415 actually, you know, if you,
NOTE Confidence: 0.96692467

00:13:12.575 --> 00:13:13.615 you know, in a foggy
NOTE Confidence: 0.96692467

00:13:13.615 --> 00:13:15.215 day. Right? If you see,
NOTE Confidence: 0.96692467

00:13:15.215 --> 00:13:16.755 you know, what's going on,
NOTE Confidence: 0.9447213

00:13:17.170 --> 00:13:18.130 you know, actually, if you
NOTE Confidence: 0.9447213

00:13:18.130 --> 00:13:19.890 see something, you know, close
NOTE Confidence: 0.9447213

00:13:19.890 --> 00:13:21.090 by, that is easy to

NOTE Confidence: 0.9447213

00:13:21.090 --> 00:13:22.370 see. That's coming from, you

NOTE Confidence: 0.9447213

00:13:22.370 --> 00:13:24.050 know, single scattering with single

NOTE Confidence: 0.9447213

00:13:24.050 --> 00:13:24.550 reflection.

NOTE Confidence: 0.98207223

00:13:25.330 --> 00:13:26.210 Now if you go a

NOTE Confidence: 0.98207223

00:13:26.210 --> 00:13:28.050 little bit, you know, deeper

NOTE Confidence: 0.98207223

00:13:28.050 --> 00:13:29.570 in there, you still can

NOTE Confidence: 0.98207223

00:13:29.570 --> 00:13:31.295 sort of see some, you

NOTE Confidence: 0.98207223

00:13:31.295 --> 00:13:33.054 know, some something there, but

NOTE Confidence: 0.98207223

00:13:33.054 --> 00:13:34.194 it's not so easy.

NOTE Confidence: 0.9077045

00:13:34.495 --> 00:13:35.855 And this kind of actually

NOTE Confidence: 0.9077045

00:13:35.855 --> 00:13:37.235 signal can be reconstructed,

NOTE Confidence: 0.95391464

00:13:37.855 --> 00:13:39.615 or, you know, extracted from

NOTE Confidence: 0.95391464

00:13:39.615 --> 00:13:40.915 optical coherence tomography,

NOTE Confidence: 0.9426819

00:13:41.375 --> 00:13:43.475 from multifocal, you know, microscopy,

NOTE Confidence: 0.9920975

00:13:43.855 --> 00:13:45.714 from confocal, you know, microscopy.

NOTE Confidence: 0.89589745

00:13:46.529 --> 00:13:47.570 So those you you you
NOTE Confidence: 0.89589745

00:13:47.570 --> 00:13:48.690 can do that, you know,
NOTE Confidence: 0.89589745

00:13:48.690 --> 00:13:49.730 if you do this in
NOTE Confidence: 0.89589745

00:13:49.730 --> 00:13:50.390 a tissue.
NOTE Confidence: 0.98950183

00:13:51.010 --> 00:13:52.390 But if you go even
NOTE Confidence: 0.98950183

00:13:52.450 --> 00:13:53.269 deeper in,
NOTE Confidence: 0.9618847

00:13:54.050 --> 00:13:55.649 that become a mission impossible
NOTE Confidence: 0.9618847

00:13:55.649 --> 00:13:56.850 because you just cannot see
NOTE Confidence: 0.9618847

00:13:56.850 --> 00:13:58.529 anything. Right? So that is
NOTE Confidence: 0.9618847

00:13:58.529 --> 00:13:59.570 really what we want. We
NOTE Confidence: 0.9618847

00:13:59.570 --> 00:14:01.005 wanna go really deeper in,
NOTE Confidence: 0.9618847

00:14:01.485 --> 00:14:02.525 to see what's going on
NOTE Confidence: 0.9618847

00:14:02.525 --> 00:14:04.045 there. So, we want to
NOTE Confidence: 0.9618847

00:14:04.045 --> 00:14:05.105 push this frontier.
NOTE Confidence: 0.9367187

00:14:05.804 --> 00:14:07.085 So that's why I think
NOTE Confidence: 0.9367187

00:14:07.085 --> 00:14:08.545 from the imaging to biological

NOTE Confidence: 0.9367187

00:14:08.765 --> 00:14:10.684 tissue, there's two regimes. Of

NOTE Confidence: 0.9367187

00:14:10.684 --> 00:14:12.125 course, if there's nothing there,

NOTE Confidence: 0.9367187

00:14:12.125 --> 00:14:13.125 that's perfect. You just have

NOTE Confidence: 0.9367187

00:14:13.125 --> 00:14:14.220 a lens you can image

NOTE Confidence: 0.9367187

00:14:14.220 --> 00:14:15.820 it perfectly. Right? For example,

NOTE Confidence: 0.9367187

00:14:15.820 --> 00:14:16.860 if you can make your

NOTE Confidence: 0.9367187

00:14:16.860 --> 00:14:18.380 brain become transparent, then you

NOTE Confidence: 0.9367187

00:14:18.380 --> 00:14:19.820 can just do that. But

NOTE Confidence: 0.9367187

00:14:19.820 --> 00:14:21.420 if you, have some, you

NOTE Confidence: 0.9367187

00:14:21.420 --> 00:14:23.360 know, like a slight aberrations

NOTE Confidence: 0.9363903

00:14:23.820 --> 00:14:25.339 or, like, the scatterings, you

NOTE Confidence: 0.9363903

00:14:25.339 --> 00:14:26.720 see this kind of distorted

NOTE Confidence: 0.9363903

00:14:26.860 --> 00:14:27.980 image, but you still can

NOTE Confidence: 0.9363903

00:14:27.980 --> 00:14:29.265 guess something out of that.

NOTE Confidence: 0.901878

00:14:29.745 --> 00:14:30.705 But what we are really

NOTE Confidence: 0.901878

00:14:30.705 --> 00:14:31.985 interested in, you go really
NOTE Confidence: 0.901878

00:14:31.985 --> 00:14:33.185 deeper in and then you
NOTE Confidence: 0.901878

00:14:33.185 --> 00:14:34.145 see all this kind of
NOTE Confidence: 0.901878

00:14:34.145 --> 00:14:35.925 scattering, give you a scattering,
NOTE Confidence: 0.901878

00:14:36.145 --> 00:14:37.585 like a speckle pattern. We
NOTE Confidence: 0.901878

00:14:37.585 --> 00:14:38.865 just cannot see anything anymore.
NOTE Confidence: 0.901878

00:14:38.865 --> 00:14:39.745 Right? But we still want
NOTE Confidence: 0.901878

00:14:39.745 --> 00:14:40.945 to see something. So how
NOTE Confidence: 0.901878

00:14:40.945 --> 00:14:42.145 can we get you know,
NOTE Confidence: 0.901878

00:14:42.145 --> 00:14:43.365 how can we do that?
NOTE Confidence: 0.901878

00:14:43.610 --> 00:14:44.490 So, you know, you're not
NOTE Confidence: 0.901878

00:14:44.490 --> 00:14:46.090 to really see something deep
NOTE Confidence: 0.901878

00:14:46.090 --> 00:14:46.970 inside the way to first
NOTE Confidence: 0.901878

00:14:46.970 --> 00:14:48.570 get the light deeper in.
NOTE Confidence: 0.901878

00:14:48.570 --> 00:14:49.530 Right? Then we can probe
NOTE Confidence: 0.901878

00:14:49.530 --> 00:14:50.030 something.

NOTE Confidence: 0.9966476

00:14:50.490 --> 00:14:51.470 So the first,

NOTE Confidence: 0.9343307

00:14:52.090 --> 00:14:53.690 task is whether we can

NOTE Confidence: 0.9343307

00:14:53.690 --> 00:14:55.450 focus in light through this

NOTE Confidence: 0.9343307

00:14:55.450 --> 00:14:57.550 strongly scattering, you know, medium.

NOTE Confidence: 0.9026894

00:14:58.805 --> 00:15:00.085 So because I said, if

NOTE Confidence: 0.9026894

00:15:00.085 --> 00:15:01.205 you have light going through

NOTE Confidence: 0.9026894

00:15:01.205 --> 00:15:02.405 a scattering medium, it's become

NOTE Confidence: 0.9026894

00:15:02.405 --> 00:15:03.445 a really a speckle. Right?

NOTE Confidence: 0.9026894

00:15:03.445 --> 00:15:04.645 You don't see anything. But

NOTE Confidence: 0.9026894

00:15:04.645 --> 00:15:06.425 I want still focusing light

NOTE Confidence: 0.87966007

00:15:06.805 --> 00:15:08.905 to a spot after this

NOTE Confidence: 0.87966007

00:15:08.965 --> 00:15:10.649 strongly scattered medium. You say,

NOTE Confidence: 0.87966007

00:15:10.649 --> 00:15:11.790 how can I do that?

NOTE Confidence: 0.87966007

00:15:12.010 --> 00:15:13.209 Actually, this is basically we

NOTE Confidence: 0.87966007

00:15:13.209 --> 00:15:14.170 can use in this so

NOTE Confidence: 0.87966007

00:15:14.170 --> 00:15:15.389 called waveform shaping,
NOTE Confidence: 0.96380705

00:15:15.930 --> 00:15:17.389 or we can precompensate
NOTE Confidence: 0.99483454

00:15:18.010 --> 00:15:19.310 the effect of scattering.
NOTE Confidence: 0.93410605

00:15:19.850 --> 00:15:21.050 So in other words, if
NOTE Confidence: 0.93410605

00:15:21.050 --> 00:15:22.329 I think about I have
NOTE Confidence: 0.93410605

00:15:22.329 --> 00:15:23.475 a laser beam, I go
NOTE Confidence: 0.93410605

00:15:23.475 --> 00:15:24.855 to a specialized modulator.
NOTE Confidence: 0.92498803

00:15:25.475 --> 00:15:26.835 If I can modulate this
NOTE Confidence: 0.92498803

00:15:26.835 --> 00:15:27.335 wavefront
NOTE Confidence: 0.9200489

00:15:27.875 --> 00:15:29.315 in a smart way, and
NOTE Confidence: 0.9200489

00:15:29.315 --> 00:15:30.515 then when the light is
NOTE Confidence: 0.9200489

00:15:30.515 --> 00:15:32.275 scattered from different, you know,
NOTE Confidence: 0.9200489

00:15:32.355 --> 00:15:34.135 paths into this particular
NOTE Confidence: 0.9147976

00:15:34.515 --> 00:15:36.695 position, they can interfere constructively,
NOTE Confidence: 0.8479561

00:15:37.075 --> 00:15:38.275 and some they can greatly
NOTE Confidence: 0.8479561

00:15:38.275 --> 00:15:39.790 enhance the intensity at this

NOTE Confidence: 0.8479561

00:15:39.790 --> 00:15:41.010 position with which.

NOTE Confidence: 0.91720086

00:15:41.389 --> 00:15:42.510 So this, you can really

NOTE Confidence: 0.91720086

00:15:42.510 --> 00:15:43.790 get a light deeper in,

NOTE Confidence: 0.91720086

00:15:43.790 --> 00:15:45.070 and people have already shown

NOTE Confidence: 0.91720086

00:15:45.070 --> 00:15:45.570 that.

NOTE Confidence: 0.9708415

00:15:46.110 --> 00:15:48.050 Actually, this enhancement originally,

NOTE Confidence: 0.9393553

00:15:48.750 --> 00:15:50.029 become getting to a thousand

NOTE Confidence: 0.9393553

00:15:50.029 --> 00:15:51.870 times higher. Now, actually, people

NOTE Confidence: 0.9393553

00:15:51.870 --> 00:15:52.990 can go to one hundred

NOTE Confidence: 0.9393553

00:15:52.990 --> 00:15:54.450 thousand times stronger

NOTE Confidence: 0.9894727

00:15:54.885 --> 00:15:55.385 intensity

NOTE Confidence: 0.9369157

00:15:56.085 --> 00:15:56.965 enhancement. So that you can

NOTE Confidence: 0.9369157

00:15:56.965 --> 00:15:58.245 really enhance the intensity at

NOTE Confidence: 0.9369157

00:15:58.245 --> 00:15:58.985 some location.

NOTE Confidence: 0.9075765

00:15:59.765 --> 00:16:01.205 So now if you have

NOTE Confidence: 0.9075765

00:16:01.205 --> 00:16:02.245 a way to do that,
NOTE Confidence: 0.9075765

00:16:02.245 --> 00:16:03.525 to develop to get the
NOTE Confidence: 0.9075765

00:16:03.525 --> 00:16:04.725 light in there to excite
NOTE Confidence: 0.9075765

00:16:04.725 --> 00:16:05.465 some molecules,
NOTE Confidence: 0.9908848

00:16:05.845 --> 00:16:07.205 to do the imaging, we
NOTE Confidence: 0.9908848

00:16:07.205 --> 00:16:08.665 need to scan these positions.
NOTE Confidence: 0.93640393

00:16:09.020 --> 00:16:10.060 If we can scan these
NOTE Confidence: 0.93640393

00:16:10.060 --> 00:16:11.340 positions, now we can get,
NOTE Confidence: 0.93640393

00:16:11.660 --> 00:16:12.880 we can get the image.
NOTE Confidence: 0.93640393

00:16:13.100 --> 00:16:14.460 And this one, actually, people
NOTE Confidence: 0.93640393

00:16:14.460 --> 00:16:15.500 have tried to work using
NOTE Confidence: 0.93640393

00:16:15.500 --> 00:16:16.700 this for the memory effect.
NOTE Confidence: 0.93640393

00:16:16.700 --> 00:16:17.500 I don't have time to
NOTE Confidence: 0.93640393

00:16:17.500 --> 00:16:18.860 get into that. But I
NOTE Confidence: 0.93640393

00:16:18.860 --> 00:16:20.240 want to show one example
NOTE Confidence: 0.9149599

00:16:20.700 --> 00:16:22.540 which people try to, not

NOTE Confidence: 0.9149599

00:16:22.540 --> 00:16:23.025 my group,

NOTE Confidence: 0.90979767

00:16:23.585 --> 00:16:25.505 but actually, people try to

NOTE Confidence: 0.90979767

00:16:25.505 --> 00:16:27.425 show that you can, do

NOTE Confidence: 0.90979767

00:16:27.425 --> 00:16:29.845 this optogenetic control of cell

NOTE Confidence: 0.90979767

00:16:29.985 --> 00:16:31.825 signaling pathway so there's a

NOTE Confidence: 0.90979767

00:16:31.825 --> 00:16:34.485 highly scarring, skeleton mouse skull.

NOTE Confidence: 0.9299062

00:16:34.945 --> 00:16:35.920 So, basically, if you have

NOTE Confidence: 0.9299062

00:16:35.920 --> 00:16:37.120 a, you know, skull, it

NOTE Confidence: 0.9299062

00:16:37.120 --> 00:16:38.560 is highly scattering. If you

NOTE Confidence: 0.9299062

00:16:38.560 --> 00:16:39.839 just send a light through

NOTE Confidence: 0.9299062

00:16:39.839 --> 00:16:42.560 it, using objective lens, you

NOTE Confidence: 0.9299062

00:16:42.560 --> 00:16:44.000 just don't get anything. You're

NOTE Confidence: 0.9299062

00:16:44.000 --> 00:16:45.220 diffused away.

NOTE Confidence: 0.9061467

00:16:45.600 --> 00:16:46.399 Of course, you can say

NOTE Confidence: 0.9061467

00:16:46.399 --> 00:16:47.440 we can't use an optical

NOTE Confidence: 0.9061467

00:16:47.440 --> 00:16:48.720 fiber, which is still really
NOTE Confidence: 0.9061467

00:16:48.720 --> 00:16:50.180 important, you know, technology,
NOTE Confidence: 0.9692128

00:16:50.965 --> 00:16:52.165 but the question is this
NOTE Confidence: 0.9692128

00:16:52.165 --> 00:16:53.545 will be somehow invasive.
NOTE Confidence: 0.9692443

00:16:54.645 --> 00:16:55.525 So how we can do
NOTE Confidence: 0.9692443

00:16:55.525 --> 00:16:56.345 it noninvasively,
NOTE Confidence: 0.83151263

00:16:57.285 --> 00:16:58.565 and that's that's what people
NOTE Confidence: 0.83151263

00:16:58.565 --> 00:16:59.845 have shown that by shaping
NOTE Confidence: 0.83151263

00:16:59.845 --> 00:17:00.825 this wavefront,
NOTE Confidence: 0.8961801

00:17:01.525 --> 00:17:03.205 we can really, focus, you
NOTE Confidence: 0.8961801

00:17:03.205 --> 00:17:04.425 know, deep inside,
NOTE Confidence: 0.89842045

00:17:04.950 --> 00:17:06.630 you know, through this scattering
NOTE Confidence: 0.89842045

00:17:06.630 --> 00:17:08.549 skull. And then by scanning
NOTE Confidence: 0.89842045

00:17:08.549 --> 00:17:10.309 this spot, you know, you
NOTE Confidence: 0.89842045

00:17:10.309 --> 00:17:11.929 can get the image there.
NOTE Confidence: 0.96222395

00:17:12.630 --> 00:17:13.750 But then you say, how

NOTE Confidence: 0.96222395
00:17:13.750 --> 00:17:14.869 can I know where I
NOTE Confidence: 0.96222395
00:17:14.869 --> 00:17:16.149 focus the inside? I I
NOTE Confidence: 0.96222395
00:17:16.149 --> 00:17:17.350 don't even, you know, drill
NOTE Confidence: 0.96222395
00:17:17.350 --> 00:17:18.070 a hole. How can I
NOTE Confidence: 0.96222395
00:17:18.070 --> 00:17:19.130 see what is inside?
NOTE Confidence: 0.9814842
00:17:19.695 --> 00:17:20.815 To do that, we need
NOTE Confidence: 0.9814842
00:17:20.815 --> 00:17:21.715 a guide star.
NOTE Confidence: 0.96460843
00:17:22.174 --> 00:17:23.455 A guide star, you know,
NOTE Confidence: 0.96460843
00:17:23.455 --> 00:17:25.075 can be fluorescence markers,
NOTE Confidence: 0.9890612
00:17:25.534 --> 00:17:27.315 can be nonlinear optical particles,
NOTE Confidence: 0.9485211
00:17:28.174 --> 00:17:29.294 can be, you know, some
NOTE Confidence: 0.9485211
00:17:29.294 --> 00:17:31.075 some people using photo acoustic
NOTE Confidence: 0.9485211
00:17:31.134 --> 00:17:31.634 feedback
NOTE Confidence: 0.95581925
00:17:31.950 --> 00:17:33.789 or ultrasound or kinetic guide
NOTE Confidence: 0.95581925
00:17:33.789 --> 00:17:35.309 stars. So there's many different
NOTE Confidence: 0.95581925

00:17:35.309 --> 00:17:36.350 type of guide stars people

NOTE Confidence: 0.95581925

00:17:36.350 --> 00:17:37.250 have been developed

NOTE Confidence: 0.94282126

00:17:37.789 --> 00:17:39.409 over the last, decade,

NOTE Confidence: 0.94339

00:17:40.029 --> 00:17:41.950 try to really help to

NOTE Confidence: 0.94339

00:17:41.950 --> 00:17:43.789 focus in light deep into

NOTE Confidence: 0.94339

00:17:43.789 --> 00:17:45.115 the system there.

NOTE Confidence: 0.9812262

00:17:45.815 --> 00:17:46.775 So there has been a

NOTE Confidence: 0.9812262

00:17:46.775 --> 00:17:47.575 lot of work in there,

NOTE Confidence: 0.9812262

00:17:47.575 --> 00:17:48.535 so I don't have time

NOTE Confidence: 0.9812262

00:17:48.535 --> 00:17:49.734 to get into that. But

NOTE Confidence: 0.9812262

00:17:49.734 --> 00:17:50.795 I think this is basically

NOTE Confidence: 0.8647196

00:17:51.415 --> 00:17:52.855 a wavefront shaping maybe allow

NOTE Confidence: 0.8647196

00:17:52.855 --> 00:17:54.135 us to see something deeper

NOTE Confidence: 0.8647196

00:17:54.135 --> 00:17:55.035 into that.

NOTE Confidence: 0.9095537

00:17:56.055 --> 00:17:57.300 Then you say, well, fine.

NOTE Confidence: 0.9095537

00:17:57.300 --> 00:17:58.580 You probably can go somewhere

NOTE Confidence: 0.9095537

00:17:58.580 --> 00:17:59.780 deeper in, but how but,

NOTE Confidence: 0.9095537

00:18:00.260 --> 00:18:01.140 you still need to put

NOTE Confidence: 0.9095537

00:18:01.140 --> 00:18:02.420 something into your system like

NOTE Confidence: 0.9095537

00:18:02.420 --> 00:18:03.380 a guide star to help

NOTE Confidence: 0.9095537

00:18:03.380 --> 00:18:04.660 you. Right? But how about

NOTE Confidence: 0.9095537

00:18:04.660 --> 00:18:05.560 complete noninvasive?

NOTE Confidence: 0.9875409

00:18:06.980 --> 00:18:08.180 If we really have complete

NOTE Confidence: 0.9875409

00:18:08.180 --> 00:18:08.680 noninvasive,

NOTE Confidence: 0.8631278

00:18:08.980 --> 00:18:11.300 there's another technology called a

NOTE Confidence: 0.8631278

00:18:11.300 --> 00:18:13.415 called a diffusive optical tomography.

NOTE Confidence: 0.9855662

00:18:14.275 --> 00:18:15.255 So this is basically,

NOTE Confidence: 0.99243134

00:18:15.715 --> 00:18:16.615 has been widely

NOTE Confidence: 0.87453824

00:18:17.075 --> 00:18:18.535 used in brain imaging.

NOTE Confidence: 0.9520025

00:18:19.235 --> 00:18:20.515 Basically, you know, you can

NOTE Confidence: 0.9520025

00:18:20.515 --> 00:18:22.115 see array of, you know,

NOTE Confidence: 0.8749764

00:18:22.755 --> 00:18:24.695 laser diodes or LEDs,
NOTE Confidence: 0.8417046

00:18:25.795 --> 00:18:27.430 placed on, you know, together
NOTE Confidence: 0.8417046

00:18:27.430 --> 00:18:28.710 with the, you know, these
NOTE Confidence: 0.8417046

00:18:28.710 --> 00:18:30.650 photo detectors, they are interleaved
NOTE Confidence: 0.8417046

00:18:30.790 --> 00:18:32.550 and and placed on the
NOTE Confidence: 0.8417046

00:18:32.550 --> 00:18:33.050 skull.
NOTE Confidence: 0.89912415

00:18:33.830 --> 00:18:35.350 So, I mean, what happened
NOTE Confidence: 0.89912415

00:18:35.350 --> 00:18:36.630 to that when the you
NOTE Confidence: 0.89912415

00:18:36.630 --> 00:18:37.910 know, from a light source,
NOTE Confidence: 0.89912415

00:18:37.910 --> 00:18:39.030 you can the light can
NOTE Confidence: 0.89912415

00:18:39.030 --> 00:18:40.230 be injected. This usually is
NOTE Confidence: 0.89912415

00:18:40.230 --> 00:18:41.734 a near infrared light, which
NOTE Confidence: 0.89912415

00:18:41.734 --> 00:18:43.575 has less absorption and less
NOTE Confidence: 0.89912415

00:18:43.575 --> 00:18:44.615 scattering so it can go
NOTE Confidence: 0.89912415

00:18:44.615 --> 00:18:45.595 through the skull.
NOTE Confidence: 0.95864713

00:18:46.055 --> 00:18:46.715 And then

NOTE Confidence: 0.92913467
00:18:47.494 --> 00:18:49.655 get into this brain, and
NOTE Confidence: 0.92913467
00:18:49.655 --> 00:18:50.775 after all this kind of
NOTE Confidence: 0.92913467
00:18:50.775 --> 00:18:53.115 scattering inside, a small component
NOTE Confidence: 0.92913467
00:18:53.335 --> 00:18:54.875 can be really remitted
NOTE Confidence: 0.99016124
00:18:55.255 --> 00:18:57.150 at some distance away from
NOTE Confidence: 0.99016124
00:18:57.150 --> 00:18:59.169 the original injection location.
NOTE Confidence: 0.98055696
00:19:00.190 --> 00:19:00.690 And,
NOTE Confidence: 0.9979435
00:19:00.990 --> 00:19:01.490 usually,
NOTE Confidence: 0.9781564
00:19:01.869 --> 00:19:03.309 those kind of remitted light
NOTE Confidence: 0.9781564
00:19:03.309 --> 00:19:05.490 will carry information deep inside
NOTE Confidence: 0.9781564
00:19:05.630 --> 00:19:06.210 the brain.
NOTE Confidence: 0.98330855
00:19:06.590 --> 00:19:07.789 You can see that if
NOTE Confidence: 0.98330855
00:19:07.789 --> 00:19:09.309 you further increase the distance
NOTE Confidence: 0.98330855
00:19:09.309 --> 00:19:10.770 between source and the detector,
NOTE Confidence: 0.8545628
00:19:11.425 --> 00:19:12.145 the the the light had
NOTE Confidence: 0.8545628

00:19:12.145 --> 00:19:13.825 to go deeper even deeper
NOTE Confidence: 0.8545628

00:19:13.825 --> 00:19:15.285 in would take information
NOTE Confidence: 0.9861853

00:19:15.585 --> 00:19:17.125 even from a deeper regime.
NOTE Confidence: 0.9861853

00:19:17.185 --> 00:19:18.085 That is better.
NOTE Confidence: 0.98743886

00:19:18.785 --> 00:19:20.145 But what is the, you
NOTE Confidence: 0.98743886

00:19:20.145 --> 00:19:20.645 know,
NOTE Confidence: 0.9966245

00:19:20.945 --> 00:19:21.445 difficulty?
NOTE Confidence: 0.98790795

00:19:21.825 --> 00:19:23.105 The difficulty is the signal
NOTE Confidence: 0.98790795

00:19:23.105 --> 00:19:24.850 is very weak. If you
NOTE Confidence: 0.98790795

00:19:24.850 --> 00:19:26.450 want to increase the distance
NOTE Confidence: 0.98790795

00:19:26.450 --> 00:19:27.830 between source and the detector,
NOTE Confidence: 0.98790795

00:19:28.049 --> 00:19:29.649 the signal scales as one
NOTE Confidence: 0.98790795

00:19:29.649 --> 00:19:31.270 over this distance squared.
NOTE Confidence: 0.9584099

00:19:31.809 --> 00:19:32.770 So if you double the
NOTE Confidence: 0.9584099

00:19:32.770 --> 00:19:33.970 distance, that means you are
NOTE Confidence: 0.9584099

00:19:33.970 --> 00:19:35.090 going to, you know, have

NOTE Confidence: 0.9584099
00:19:35.090 --> 00:19:37.270 your intestine four times weaker.
NOTE Confidence: 0.9940567
00:19:38.044 --> 00:19:39.605 So what is yeah. So
NOTE Confidence: 0.9940567
00:19:39.725 --> 00:19:40.924 yeah. So what is our
NOTE Confidence: 0.9940567
00:19:40.924 --> 00:19:41.424 approach?
NOTE Confidence: 0.94706273
00:19:41.725 --> 00:19:43.085 Our approach is to shape
NOTE Confidence: 0.94706273
00:19:43.085 --> 00:19:44.845 the input wave front so
NOTE Confidence: 0.94706273
00:19:44.845 --> 00:19:46.684 that we can really enhance
NOTE Confidence: 0.94706273
00:19:46.684 --> 00:19:47.825 the light injection
NOTE Confidence: 0.95528984
00:19:48.125 --> 00:19:49.424 into this brain,
NOTE Confidence: 0.88921916
00:19:49.725 --> 00:19:51.085 or the diffuse of media
NOTE Confidence: 0.88921916
00:19:51.085 --> 00:19:51.800 so so that we can
NOTE Confidence: 0.88921916
00:19:51.800 --> 00:19:53.820 enhance this remitted signal.
NOTE Confidence: 0.8968236
00:19:54.359 --> 00:19:55.800 So, basically, we're showing here
NOTE Confidence: 0.8968236
00:19:55.800 --> 00:19:57.340 that indeed we can actually
NOTE Confidence: 0.8968236
00:19:57.559 --> 00:19:59.900 enhance this, okay, remission signal,
NOTE Confidence: 0.8968236

00:19:59.960 --> 00:20:01.980 the, remission signal enhancement

NOTE Confidence: 0.9782821

00:20:02.359 --> 00:20:04.140 can approach about ten times.

NOTE Confidence: 0.9830084

00:20:04.515 --> 00:20:05.815 And meanwhile, the sensitivity

NOTE Confidence: 0.9892911

00:20:06.275 --> 00:20:07.795 of this remitted signal to

NOTE Confidence: 0.9892911

00:20:07.795 --> 00:20:10.275 the internal absorption change can

NOTE Confidence: 0.9892911

00:20:10.275 --> 00:20:11.815 also be increased ten times.

NOTE Confidence: 0.9132432

00:20:12.435 --> 00:20:13.555 So I think my time

NOTE Confidence: 0.9132432

00:20:13.555 --> 00:20:14.755 is, I mean, getting close.

NOTE Confidence: 0.9132432

00:20:14.755 --> 00:20:15.475 So let me try to

NOTE Confidence: 0.9132432

00:20:15.475 --> 00:20:16.930 finish with last thing, and

NOTE Confidence: 0.9132432

00:20:16.930 --> 00:20:17.810 then I'll be I'll be

NOTE Confidence: 0.9132432

00:20:17.810 --> 00:20:19.570 done. So, of course, I

NOTE Confidence: 0.9132432

00:20:19.570 --> 00:20:20.450 said this one, we want

NOTE Confidence: 0.9132432

00:20:20.450 --> 00:20:21.410 to do non invasive. Non

NOTE Confidence: 0.9132432

00:20:21.410 --> 00:20:22.450 invasive can only go you

NOTE Confidence: 0.9132432

00:20:22.450 --> 00:20:23.490 so far. You can know

NOTE Confidence: 0.9132432
00:20:23.570 --> 00:20:25.090 eventually, if you really wanna
NOTE Confidence: 0.9132432
00:20:25.090 --> 00:20:26.369 go very deeply in, we
NOTE Confidence: 0.9132432
00:20:26.369 --> 00:20:27.170 want to go through the,
NOTE Confidence: 0.9132432
00:20:27.410 --> 00:20:28.850 you know, the fiber using
NOTE Confidence: 0.9132432
00:20:28.850 --> 00:20:30.130 the endoscope. Right? You you
NOTE Confidence: 0.9132432
00:20:30.130 --> 00:20:31.350 want to dip in there.
NOTE Confidence: 0.85182077
00:20:31.654 --> 00:20:32.534 And the the best is
NOTE Confidence: 0.85182077
00:20:32.534 --> 00:20:34.294 to use multimode fiber because
NOTE Confidence: 0.85182077
00:20:34.294 --> 00:20:35.654 they have many more spatial
NOTE Confidence: 0.85182077
00:20:35.654 --> 00:20:37.034 channels, carry more information.
NOTE Confidence: 0.96835816
00:20:37.494 --> 00:20:38.774 But the multimode fiber also
NOTE Confidence: 0.96835816
00:20:38.774 --> 00:20:40.215 give you speckle pattern because
NOTE Confidence: 0.96835816
00:20:40.215 --> 00:20:41.755 of this random mode mixing.
NOTE Confidence: 0.88626426
00:20:42.294 --> 00:20:43.414 So, again, we can use
NOTE Confidence: 0.88626426
00:20:43.414 --> 00:20:44.955 a wavefront shaping to focusing
NOTE Confidence: 0.88626426

00:20:45.014 --> 00:20:45.514 light,
NOTE Confidence: 0.95105857

00:20:46.020 --> 00:20:47.619 you know, at the distal
NOTE Confidence: 0.95105857

00:20:47.619 --> 00:20:49.220 end of the fiber by,
NOTE Confidence: 0.95105857

00:20:49.380 --> 00:20:50.420 you know, using this kind
NOTE Confidence: 0.95105857

00:20:50.420 --> 00:20:52.280 of same technique, specialized modulator.
NOTE Confidence: 0.96885836

00:20:53.060 --> 00:20:54.180 In fact, using this kind
NOTE Confidence: 0.96885836

00:20:54.180 --> 00:20:55.800 of, you know, specialized modulator,
NOTE Confidence: 0.92903745

00:20:56.100 --> 00:20:57.460 we can control not only
NOTE Confidence: 0.92903745

00:20:57.460 --> 00:20:58.500 the output, you know, the
NOTE Confidence: 0.92903745

00:20:58.580 --> 00:20:59.540 at a distal end of
NOTE Confidence: 0.92903745

00:20:59.540 --> 00:21:00.740 the fiber, what's a spatial
NOTE Confidence: 0.92903745

00:21:00.740 --> 00:21:02.265 pattern, but also what is
NOTE Confidence: 0.92903745

00:21:02.265 --> 00:21:04.025 a temporal pulse shape and
NOTE Confidence: 0.92903745

00:21:04.025 --> 00:21:05.165 also what is a polarization
NOTE Confidence: 0.92903745

00:21:05.385 --> 00:21:06.665 state. And all this can
NOTE Confidence: 0.92903745

00:21:06.665 --> 00:21:08.025 be used to probe the,

NOTE Confidence: 0.92903745
00:21:08.025 --> 00:21:09.465 you know, the molecules or
NOTE Confidence: 0.92903745
00:21:09.465 --> 00:21:10.744 cells at the other end
NOTE Confidence: 0.92903745
00:21:10.744 --> 00:21:12.765 of this, monte mode fiber.
NOTE Confidence: 0.92903745
00:21:12.825 --> 00:21:13.785 So with that, I think
NOTE Confidence: 0.92903745
00:21:13.785 --> 00:21:14.825 I'll stop here, and thank
NOTE Confidence: 0.92903745
00:21:14.825 --> 00:21:15.805 you for your attention.
NOTE Confidence: 0.9988208
00:21:22.320 --> 00:21:22.980 Thank you.
NOTE Confidence: 0.99857235
00:21:23.440 --> 00:21:24.480 We actually have time for
NOTE Confidence: 0.99857235
00:21:24.480 --> 00:21:25.140 some questions.
NOTE Confidence: 0.9475665
00:21:36.575 --> 00:21:37.855 Thank you. So I was
NOTE Confidence: 0.9475665
00:21:37.855 --> 00:21:38.335 wondering,
NOTE Confidence: 0.9939047
00:21:38.734 --> 00:21:40.195 in the deep tissue imaging,
NOTE Confidence: 0.9988278
00:21:40.654 --> 00:21:42.034 how is it calculated
NOTE Confidence: 0.87988204
00:21:42.335 --> 00:21:44.140 what the correction would be
NOTE Confidence: 0.87988204
00:21:44.140 --> 00:21:45.340 for the wavefront going in?
NOTE Confidence: 0.87988204

00:21:45.340 --> 00:21:45.900 I know you don't you
NOTE Confidence: 0.87988204

00:21:45.900 --> 00:21:46.460 don't want to get too
NOTE Confidence: 0.87988204

00:21:46.460 --> 00:21:47.340 too much of details, but
NOTE Confidence: 0.87988204

00:21:47.340 --> 00:21:48.560 how how would you know
NOTE Confidence: 0.89171946

00:21:48.940 --> 00:21:50.320 how to apply that correction?
NOTE Confidence: 0.89171946

00:21:50.380 --> 00:21:51.100 So the question is how
NOTE Confidence: 0.89171946

00:21:51.100 --> 00:21:51.740 do we know what the
NOTE Confidence: 0.89171946

00:21:51.740 --> 00:21:52.540 front end to send in
NOTE Confidence: 0.89171946

00:21:52.540 --> 00:21:53.580 to the that's what I
NOTE Confidence: 0.89171946

00:21:53.580 --> 00:21:54.380 said. We need a guide
NOTE Confidence: 0.89171946

00:21:54.380 --> 00:21:54.880 star.
NOTE Confidence: 0.940499

00:21:55.275 --> 00:21:55.994 If you have a guide
NOTE Confidence: 0.940499

00:21:55.994 --> 00:21:57.295 star, it is a fluorescent
NOTE Confidence: 0.940499

00:21:57.355 --> 00:21:58.635 marker with some, you know,
NOTE Confidence: 0.940499

00:21:58.635 --> 00:22:00.395 a nonlinear particles or even
NOTE Confidence: 0.940499

00:22:00.395 --> 00:22:02.415 people using some bubble bursting,

NOTE Confidence: 0.940499
00:22:02.475 --> 00:22:03.675 whatever, to give you acoustic
NOTE Confidence: 0.940499
00:22:03.675 --> 00:22:04.555 signal. If you have something
NOTE Confidence: 0.940499
00:22:04.555 --> 00:22:05.595 in there, then that will
NOTE Confidence: 0.940499
00:22:05.595 --> 00:22:06.955 tells you what is the
NOTE Confidence: 0.940499
00:22:06.955 --> 00:22:08.395 input wavefront. Indeed, you need
NOTE Confidence: 0.940499
00:22:08.395 --> 00:22:09.215 something inside.
NOTE Confidence: 0.9435251
00:22:10.990 --> 00:22:12.109 On that note, like, do
NOTE Confidence: 0.9435251
00:22:12.109 --> 00:22:13.150 you actually do you think
NOTE Confidence: 0.9435251
00:22:13.150 --> 00:22:14.030 you can so back back
NOTE Confidence: 0.9435251
00:22:14.030 --> 00:22:15.230 to the machine learning aspect
NOTE Confidence: 0.9435251
00:22:15.230 --> 00:22:16.670 also, can you generate sort
NOTE Confidence: 0.9435251
00:22:16.670 --> 00:22:18.670 of, like, reasonably random inputs
NOTE Confidence: 0.9435251
00:22:18.670 --> 00:22:20.190 and actually learn how you
NOTE Confidence: 0.9435251
00:22:20.190 --> 00:22:21.710 can map it with various,
NOTE Confidence: 0.9435251
00:22:21.710 --> 00:22:22.830 like, outputs in a in
NOTE Confidence: 0.9435251

00:22:22.830 --> 00:22:24.225 a control system. Yeah. I
NOTE Confidence: 0.9435251

00:22:24.225 --> 00:22:24.865 think that's a very good
NOTE Confidence: 0.9435251

00:22:24.865 --> 00:22:25.825 question. Whether we can use
NOTE Confidence: 0.9435251

00:22:25.825 --> 00:22:26.785 a machine learning to learn
NOTE Confidence: 0.9435251

00:22:26.785 --> 00:22:27.744 what is wavefront we need
NOTE Confidence: 0.9435251

00:22:27.744 --> 00:22:28.465 to do. Right? Yes. I
NOTE Confidence: 0.9435251

00:22:28.465 --> 00:22:29.585 think people have been trying
NOTE Confidence: 0.9435251

00:22:29.585 --> 00:22:31.425 that. If you have enough,
NOTE Confidence: 0.9435251

00:22:31.505 --> 00:22:33.185 you know, data, then you
NOTE Confidence: 0.9435251

00:22:33.185 --> 00:22:34.305 can really use this to
NOTE Confidence: 0.9435251

00:22:34.305 --> 00:22:35.665 find out what is a
NOTE Confidence: 0.9435251

00:22:35.665 --> 00:22:37.205 new wavefront to do focusing
NOTE Confidence: 0.9435251

00:22:37.450 --> 00:22:39.210 afterwards. But, the thing is
NOTE Confidence: 0.9435251

00:22:39.210 --> 00:22:40.570 that usually the biological tissue
NOTE Confidence: 0.9435251

00:22:40.570 --> 00:22:41.850 is moving, so you you
NOTE Confidence: 0.9435251

00:22:41.850 --> 00:22:42.810 need to learn this very

NOTE Confidence: 0.9435251

00:22:42.810 --> 00:22:44.090 fast. Mhmm. So that is

NOTE Confidence: 0.9435251

00:22:44.090 --> 00:22:45.609 usually the typical challenge. Right.

NOTE Confidence: 0.9435251

00:22:45.609 --> 00:22:46.970 So good feedback is important.

NOTE Confidence: 0.9435251

00:22:46.970 --> 00:22:48.410 Good feedback is important and

NOTE Confidence: 0.9435251

00:22:48.410 --> 00:22:49.869 a quick one. Yep. Yep.

NOTE Confidence: 0.97666085

00:22:50.890 --> 00:22:52.544 Okay. Great. Thanks, Wei.