TED演讲者：Mary Lou Jepsen | 玛丽•娄•吉普森

演讲标题：How we can use light to see deep inside our bodies and brains | 如何利用光来观察我们的身体与脑部。

内容概要：In a series of mind-bending demos, inventor Mary Lou Jepsen shows how we can use red light to see and potentially stimulate what's inside our bodies and brains. Taking us to the edge of optical physics, Jepsen unveils new technologies that utilize light and sound to track tumors, measure neural activity and could possibly replace the MRI machine with a cheaper, more efficient and wearable system.

透过一系列顛覆大脑的展示，发明家玛丽•娄•吉普森向我们展示如何利用红光来观察并刺激我们的身体与大脑。吉普森带我们看尖端的光子医学新科技，揭密利用光与声音来追踪肿瘤与量测神经元的活动。这个较便宜、更有效率的穿戴式系统有可能取代核磁共振仪器。

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People don't realize that red light and **benign near-infrared** light go right through your hand, just like this.	人們不了解 這個紅光和這個溫和的近紅外光 可以穿透你的手,就像這樣。[00:12]
This fact could enable better, faster and cheaper health care.	這個原理可以實現更好、 更快、更便宜的醫療照顧。[00:22]
Our **translucence** is key here.	我們的半透性是關鍵。[00:28]
I'm going to show you how we use this key and a couple of other keys to see deep inside our bodies and brains.	我即將要向各位展示 如何利用這個以及其他的關鍵 來看透我們身體與大腦的深層。[00:31]
OK, so first up ...	好,首先...[00:39]
You see this laser **pointer** and the spot it makes on my hand?	各位看到這支雷射筆 與我手上這個光點嗎? [00:42]
The light goes right through my hand -- if we could bring the lights down, please -- as I've already shown.	這道光穿透了我的手—— 請把現場燈光轉弱—— 正如我已經展示的。[00:47]
But you can no longer see that laser spot.	但各位已經看不到那個雷射點了,[00:52]
You see my hand glow.	只看到我手上的光暈,[00:55]
That's because the light spreads out, it **scatters**.	那是因為光線分開、分散了,[00:57]
I need you to understand what **scattering** is, so I can show you how we get rid of it and see deep inside our bodies and brains.	我需要各位先了解 甚麼是光的分散現象, 這樣才能讓各位明白如何移除它, 並看到我們身體與大腦的深層內部。[01:02]

benign: adj.良性的；和藹的，亲切的；吉利的/ **near-infrared:** 近红外 **translucence:** n.半透明 **pointer:** n.指针;指示器;教鞭;暗示 **scatters:** vi.分散,散开;散射/vt.使散射;使散开,使分散;使散播,使撒播/n.分散;散播,撒播 **scattering:** n.散射;分散/adj.分散的/v.散射;散布;驱散(scatter的ing形式)

So, I've got a piece of chicken back here.	後面這裡有一塊雞肉。[01:12]
(Laughter) It's raw.	（笑聲） 它是生的。[01:15]
Putting on some gloves.	我戴上手套。[01:19]
It's got the same **optical** properties as human flesh.	雞肉與人肉有相同的光學特性。[01:21]
So, here's the chicken ... putting it on the light.	這是雞肉...把它放到光上面。[01:29]
Can you see, the light goes right through?	各位有看到這道光穿越過雞肉了嗎? [01:34]
I also **implanted** a tumor in that chicken.	我在雞肉裡植入了一塊腫瘤。[01:38]
Can you see it?	你們有看到嗎? [01:42]
Audience: Yes.	觀眾:有。[01:43]
Mary Lou Jepsen: So this means, using red light and infrared light, we can see tumors in human flesh.	講者:這意味著 利用紅光和紅外線光, 我們可以看到人身上的腫瘤。[01:44]
But there's a catch.	但有一個問題。[01:52]
When I throw another piece of chicken on it, the light still goes through, but you can no longer see the tumor.	如果我再放上另一塊雞肉, 光仍然可以穿越, 但你看不到腫瘤了。[01:55]
That's because the light scatters.	那是因為光被分散掉了。[02:05]
So we have to do something about the scatter so we can see the tumor.	所以我們要想辦法克服光分散的問題, 這樣我們才能看到腫瘤。[02:08]
We have to de-scatter the light.	我們要把光反分散。[02:13]
So ...	所以....[02:17]

optical: adj.光学的；眼睛的，视觉的 **implanted:** 植入的

A technology I spent the early part of my career on enables de-scattering.	我在職涯的早期階段 實現可以反散射的技術。[02:19]
It's called **holography**.	它叫全息攝影術,[02:24]
And it won the Nobel Prize in physics in the 70s, because of the fantastic things it enables you to do with light.	在 70 年代獲得物理諾貝爾獎, 因為這個神奇的技術, 可以幫你處理光的問題。[02:26]
This is a **hologram**.	這個就是全息影像。[02:34]
It **captures** all of the light, all of the **rays**, all of the **photons** at all of the positions and all of the angles, **simultaneously**.	它能捕捉到所有光、雷射、 所有光子的入射位置與角度, 在同一時間內全部捕捉到。[02:36]

It's amazing.	很神奇。[02:46]
To see what we can do with holography ...	為了理解這個全息圖裝置 可以做些甚麼,[02:48]
You see these **marbles**?	各位看到這些彈珠嗎? [02:52]
Look at these marbles **bouncing** off of the **barriers**, as an **analogy** to light being **scattered** by our bodies.	注意看這些 正在障礙物上彈跳著的彈珠, 這就像是光在我們體內散射的現象。[02:54]
As the marbles get to the bottom of the scattering **maze**, they're **chaotic**, they're scattering and bouncing everywhere.	當這些彈珠在這迷宮似的 彈珠檯上往下掉時, 它們會到處亂跑、散開、彈跳。[03:02]
holography: n.全息术；全息摄影；[摄][激光]全息照相术 **hologram:** n.[激光]全息图;全息摄影,全息照相 **captures:** vt.俘获;夺得/n.捕获;战利品,俘虏 **rays:** n.射线;光线(ray的复数);日光浴/v.辐射(ray的三单形式);照射 **photons:** n.[物]光子;[量子]光量子(photon的复数) **simultaneously:** adv.同时地 **marbles:** n.大理石;弹球(marble的复数);[建]大理石雕刻品/v.把...弄上大理石花纹;把肉肥瘦均匀搭配好(marble的三单形式) **bouncing:** adj.跳跃的;巨大的;活泼的/v.弹跳(bounce的ing形式) **barriers:** n.障碍;栅栏;篱笆墙(barrier的复数形式) **analogy:** n.类比；类推；类似 **scattered:** adj.分散的;散乱的 **maze:** n.迷宫;迷惑;糊涂/vt.迷失;使混乱;使困惑 **chaotic:** adj.混沌的;混乱的,无秩序的	
If we record a hologram at the bottom inside of the screen, we can record the position and angle of each marble exiting the maze.	如果我們在螢幕底部 記錄它們的全息路徑, 就能記錄到所有彈珠穿越迷宮時 各自的位置與角度。[03:10]
And then we can bring in marbles from below and have the hologram direct each marble to exactly the right position and angle, such as they emerge in a line at the top of the scatter **matrix**.	然後我們可以把彈珠從下面帶上來, 透過全息圖裝置,導引每顆彈珠 以正確的位置與角度回彈, 使它們回到一開始排隊 從散射矩陣掉下來的地方。[03:22]
We're going to do that with this.	我們要用這個來做。[03:38]
This is **optically similar to** human brain.	這個東西的光學特性 跟我們人類的大腦很像。[03:41]
I'm going to **switch to green light** now, because **green light** is brighter to your eyes than red or infrared, and I really need you to see this.	我現在要換到綠光, 因為綠光對人類的肉眼而言, 比紅光或紅外線來得更明亮, 我真的需要各位看清楚這個。[03:46]
So we're going to put a hologram in front of this brain and make a stream of light come out of it.	我們要在這個類似人腦的物體上, 放上一個全息影像裝置 然後從它後面打光。[03:55]
Seems impossible but it isn't.	看起不可思議,但真的可以。[04:04]
This is the setup you're going to see.	這是你們將要看到的設置:[04:07]
Green light.	綠光,[04:09]
Hologram here, green light going in, that's our brain.	全息影像裝置放這裡,綠光打進去, 這是我們的大腦,[04:12]
matrix: n.[数]矩阵;模型;[生物][地质]基质;母体;子宫;[地质]脉石 **optically:** adv.光学地;眼睛地;视力地 **similar to:** 与.....相似;和.....相同 **switch to:** v.切换到;转到;转变成 **green light:** 绿灯;放行;准许	
And a stream of light comes out of it.	然後一股綠光從裡面出來了。[04:18]
We just made a brain **lase** of **densely** scattering tissue.	我們剛做了 高密度散射組織的大腦雷射。[04:22]
Seems impossible, no one's done this before, you're the first public audience to ever see this.	看起來很不可思議, 之前沒有人這樣做, 各位是我第一次公開展示的觀眾。[04:27]
(Applause) What this means is that we can focus deep into tissue.	（笑聲） 也就是說,我們可以看到 組織的深層內部。[04:33]
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Our **translucency** is the first key.	我們的半透明性是第一個關鍵。[04:42]
Holography **enabling** de-scattering is the second key to enable us to see deep inside of our bodies and brains.	全息攝影裝置有 反散射的作用是第二關鍵, 如此我們就可以看到身體 與大腦的深層內部。[04:45]
You're probably thinking, "Sounds good, but what about skull and bones?	各位可能在想, 「聽起來不錯,但頭顱和骨頭呢? [04:54]
How are you going to **see through** the brain without seeing through bone?"	不看穿骨頭,怎麼能看穿大腦呢? 」[04:59]
Well, this is real human skull.	是的,這是真實的人頭骨。[05:04]
(Laughter) **No kidding**.	（笑聲） 沒開玩笑。[05:10]
But we treat this skull with great respect at our lab and here at TED.	我們很尊重這頭骨, 不管是在實驗室或 TED 演講現場。[05:13]
And **as you can see**, the red light goes right through it.	就如各位所看到的, 紅光透過去了。[05:17]
lase: vi.发出激光;以激光照射 **densely:** adv.浓密地;密集地 **translucency:** n.半透明 **enabling:** adj.授权的/v.使能够;授权给(enable的现在分词) **see through:** 识破,看穿/<非正>帮助渡过难关 **No kidding:** 说真的,不要开玩笑 **as you can see:** 正如你所看到的;你是知道的	
Goes through our bones.	穿透了我們的骨頭。[05:23]
So we can go through skull and bones and flesh with just red light.	所以只要用紅光就可以 穿透我們的頭骨、骨頭、肉體。[05:25]
Gamma rays and X-rays do that, too, but they cause tumors.	伽馬射線和 X 光也可以, 但會造成腫瘤。[05:31]
Red light is all around us.	我們的生活周遭都是紅外線。[05:35]

So, using that, I'm going to come back here and show you something more useful than making a brain lase.	用那個裝置,我回來這裡向各位展示 比大腦雷射更有用的東西。[05:38]
We challenged ourselves to see how fine we could focus through brain tissue.	我們挑戰自己 到底能把腦組織看到多細微。[05:46]
Focusing through this brain, it was such a fine focus, we put a bare camera die in front of it.	要聚焦看大腦, 它的聚焦是如此細微, 我們在它前面放了一粒相機裸晶,[05:50]
And the bare camera die ...	而這粒相機裸晶...[05:58]
Could you **turn down** the **spotlight**?	可以把現場燈光調暗一點嗎? [06:03]
OK, there it is.	好,看到它了。[06:04]
Do you see that?	你們看到了嗎? [06:06]
Each pixel is two-thousandths of a **millimeter** wide.	每個像素的寬度為千分之二毫米,[06:08]
Two **microns**.	也就是二微米大小。[06:13]
That means that spot focus -- full width half max -- is six to eight microns.	意思是,那一點的焦距, 半寬波長（FWHM） 是六到八微米。[06:14]
Gamma: n.微克;希腊语的第三个字母 **turn down:** 减小,关小,调低 **spotlight:** n.聚光灯;反光灯;公众注意的中心/vt.聚光照明;使公众注意 **millimeter:** n.[计量]毫米 **microns:** n.微米(micron的复数)	
To give you an idea of what that means: that's the diameter of the smallest **neuron** in the human brain.	為了讓各位更容易了解, 這大小相當於人類大腦裡最小神經元的直徑。[06:20]
So that means we can focus through skull and brain to a neuron.	意思是,我們能穿透頭骨和大腦 直接聚焦神經元。[06:29]
No one has seen this before, we're doing this for the first time here.	之前都沒有人看過, 我們是第一次在此展示。[06:33]
It's not impossible.	這是辦得到的。[06:38]
(Applause) We made it work with our system, so we've made a breakthrough.	（掌聲） 用我們的系統辦到的, 是重大的突破。[06:39]
(Laughter) Just to give an idea -- like, that's not just 50 marbles.	（笑聲） 只是為了讓你知道—— 這可不是僅僅 50 顆彈珠而已,[06:44]
That's billions, **trillion** of photons, all falling in line as directed by the hologram, to **ricochet** through densely scattering brain, and emerge as a focus.	而是有上億、上兆的光子 全都依照全息裝置的指揮排好了, 彈跳似地閃過密密麻麻的大腦組織, 最後通通聚焦到一個點。[06:49]
It's pretty cool.	很厲害。[07:03]
We're excited about it.	我們很興奮。[07:05]
This is an MRI machine.	這是核磁共振儀。[07:07]
It's a few million dollars, it fills a room, many people have probably been in one.	這一台要好幾百萬美金, 占用一個房間, 很多人可能用過。[07:09]
I've spent a lot of time in one.	我在一台裡面待了很久。[07:14]
It has a focus of about a millimeter -- kind of **chunky**, compared to what I just showed you.	它的影像清晰度大約一毫米, 比起我剛展示給各位看的算大。[07:15]
neuron: n.[解剖]神经元,神经单位 **trillion:** n.[数]万亿/adj.万亿的/num.[数]万亿 **ricochet:** n.跳弹;跳飞/vi.跳飞/vt.使跳飞 **chunky:** adj.矮胖的;粗短的;厚实的	
A system based on our technology could enable **dramatically** lower cost, higher resolution and smaller medical imaging.	用我們技術做的系統 成本會大大降低, 解析度增高, 和較小的醫學成像。[07:20]
So that's what we've started to do.	這是我們已經開始進行的事。[07:31]
My team and I have built a rig, a lab rig to scan out tissue.	我的團隊和我建了個實驗機台 來掃描細胞組織。[07:34]
And here it is in action.	上面是它正在運作的樣子。[07:40]
We wanted to see how good we could do.	我們想知道能做到多好。[07:42]
We've built this over the last year.	我們去年建造這個。[07:46]
And the result is, we're able to find tumors in this sample -- 70 **millimeters** deep, the light going in here, half a millimeter resolution, and that's the tumor it found.	成果就是, 我們找得到腫瘤, 在這個七公分厚的樣本裡找得到, 光線從這裡進去, 0.5 毫米的解析度, 那是它找到的腫瘤。[07:49]
You're probably looking at this, like, "Sounds good, but that's kind of a big system.	各位可能在想, 「這系統看起來是不錯, 但還是有點大。[08:05]
It's smaller than a honking-big MRI machine, **monster** MRI machine, but can you do something to shrink it down?"	是比超巨大的核磁共振儀、 核磁共振大怪物小。但你能把它縮得更小嗎? 」[08:12]
And the answer is: of course.	答案是: 當然沒問題。[08:21]
We can replace each big element in that system with a smaller component -- a little **integrated** circuit, a display chip the size of a child's **fingernail**.	我們可以把這個系統裡的每個大零件 用小零件取代—— 小型的積體電路, 像小朋友指甲一樣大小的顯示晶片。[08:24]
dramatically: adv.戏剧地；引人注目地/adv.显著地，剧烈地 **millimeters:** n.[计量]毫米(millimeter的复数形式) **monster:** n.怪物；巨人，巨兽；残忍的人/adj.巨大的，庞大的 **integrated:** adj.综合的;完整的;互相协调的/v.整合;使...成整体(integrate的过去分词) **fingernail:** n.手指甲	

A bit about my background: I've spent the last two decades **inventing**, prototype-developing and then shipping billions of dollars of consumer **electronics** -- with full custom chips -- on the hairy edge of optical physics.	聊一下我的背景: 在過去的二十年裡 運出了數十億美元的 消費性電子產品, 有著客製的晶片 擺在光學物理學產品的邊上。[08:37]
So my team and I built the big lab rig to perfect our architecture and test the corner cases and really **fine-tune** our chip designs, before spending the millions of dollars to **fabricate** each chip.	我的團隊和我建了 這個大型實驗機台, 來完善我們的作品, 並在極端條件下做測試, 在花好幾百萬大量製造生產前, 小心翼翼地微調我們的晶片設計。[08:55]
Our new chip **inventions** slim down the system, speed it up and enable rapid **scanning** and de-scattering of light to see deep into our bodies.	我們發明的新晶片 把系統瘦身了、速度變快了, 可以快速掃描及反散射光線, 好深入檢視我們身體的內部。[09:12]
This is the third key to enable better, faster and cheaper health care.	這是實現更好、更快、更便宜 醫療照顧的第三關鍵。[09:23]
This is a **mock-up** of something that can replace the **functionality** of a multimillion-dollar MRI machine into a consumer electronics price point, that you could wear as a **bandage**, line a ski hat, put inside a pillow.	這個實體模型可以取代好幾百萬 核磁共振儀的功能性, 且價位可以達到 消費性電子產品的等級, 讓你可以像綁繃帶、戴雪帽, 或放在枕頭裡。[09:33]
inventing: v.发明(invent的现在分词);创造 **electronics:** n.电子学;电子工业 **fine-tune:** vt.调整;使有规则;对进行微调 **fabricate:** vt.制造;伪造;装配 **inventions:** n.[专利]发明(invention的复数);创意曲 **scanning:** n.扫描;[计]搜索,观测;扫掠/adj.扫描的;观测的;搜索的;扫掠的/v.扫描(scan的现在分词);浏览 **mock-up:** n.伪装工事;实物模型 **functionality:** n.功能;[数]泛函性,函数性 **bandage:** n.绷带/vt.用绷带包扎	
That's what we're building.	那是我們正在建造的產品。[09:51]
(Applause) Oh, thanks!	（掌聲） 喔,謝謝！[09:53]
(Applause) So you're probably thinking, "I get the light going through our bodies.	（掌聲） 你可能會想 「我把光打進了身體 ,[09:55]
I even get the holography de-scattering the light.	甚至有了全像攝影裝置 來反分散光源 。[10:04]
But how do we use these new chip inventions, exactly, to do the scanning?"	但我們到底是如何 使用這個新的晶片產品 來進行掃描的？」[10:08]
Well, we have a sound approach.	我們用聲音,[10:13]
No, literally -- we use sound.	沒錯,我們用聲音。[10:16]
Here, these three **discs** represent the integrated circuits that we've designed, that **massively** reduce the size of our current **bulky** system.	此處這三小碟代表 我們設計的積體電路, 會大規模縮小目前的大型系統。[10:18]
One of the spots, one of the chips, **emits** a **sonic ping**, and it focuses down, and then we turn red **light on**.	其中一點,一個晶片,會發出聲音, 聲音會集中往下傳遞, 然後我們把紅燈打開。[10:29]
And the red light that goes through that sonic spot changes color slightly, much like the pitch of the **police car siren** changes as it speeds past you.	紅光經過那個聲音點 會稍微改變顏色, 有點像是警笛快速經過你身邊時 所產生的聲音變化現象。[10:39]
discs: n.磁盘(disc的复数) **massively:** adv.大量地;沉重地;庄严地 **bulky:** adj.体积大的;庞大的;笨重的 **emits:** 发出/放射/发行(emit的动词单数第三人称形式) **sonic:** adj.音速的;声音的;音波的 **ping:** n.子弹飞过空中的声音;[电子]声脉冲/vi.发出撞击声;砰地发声 **light on:** 偶然遇见(碰见,发现);停落于 **police car:** 警察巡逻车 **siren:** n.汽笛;迷人的女人;歌声动人的女歌手/adj.迷人的/vi.响着警报器行驶/vt.引诱	
There's this other thing about holography I haven't told you yet, that you need to know.	這就是我還沒告訴各位 全息攝影術的另一件事, 這個你需要知道。[10:53]
Only two **beams** of exactly the same color can make a hologram.	只有顏色完全相同的兩條光束 才能產生全息影像。[10:58]
So, that's the orange light that's coming off of the sonic spot, that's changed color slightly, and we create a **glowing** disc of orange light **underneath** a **neighboring** chip and then record a hologram on the camera chip.	所以,從聲音點出來的橘色光, 顏色稍微變了, 我們在相鄰晶片的下方 建了個發光的橙色光盤, 然後相機晶片會記錄全息影像。[11:03]
Like so.	就像這樣。[11:21]
From that hologram, we can **extract** information just about that sonic spot, because we filter out all of the red light.	我們可以從全息影像中 抽取與那個聲音點有關的訊息, 因為我們把所有的紅色光濾掉了。[11:22]
Then, we can optionally focus the light **back down** into the brain to stimulate a neuron or part of the brain.	然後,我們可以選擇 將光線聚焦到大腦中, 以刺激部分的神經元或大腦。[11:31]
And then we move on to shift the sonic focus to another spot.	接下來轉移聲音焦點到另一個位置。[11:39]
And that way, spot by spot, we scan out the brain.	用這樣的方式一點一點地掃瞄大腦。[11:44]
Our chips **decode holograms** a bit like Rosalind **Franklin decoded** this **iconic** image of X-ray **diffraction** to reveal the structure of DNA for the first time.	我們的晶片可以解讀全息影像, 這有點像是羅莎琳·富蘭克林 透過解碼 X 光繞射現象 第一次解構出 DNA 的結構時那樣。[11:49]
beams: [建]梁 **glowing:** adj.灼热的;热情洋溢的;鲜艳的/v.发光;容光焕发(glow的ing形式);发热 **underneath:** prep.在...的下面；在...的形式下；在...的支配下/adv.在下面；在底下/n.下面；底部/adj.下面的；底层的 **neighboring:** adj.邻近的;附近的	

(等于neighbouring)/v.与...为邻;位于附近(neighbor的ing形式) **extract:** vt.提取;取出;摘录;榨取/n.汁;摘录;榨出物;选粹 **back down:** 放弃;让步 **decode:** vt.[计][通信]译码,解码/vi.从事破译工作 **holograms:** n.[激光]全息图;全息照相;综合衍射图(hologram的复数) **Franklin:** n.小地主；乡绅 **decoded:** 译解 **iconic:** adj.图标的,形象的 **diffraction:** n.(光,声等的)衍射,绕射

We're doing that **electronically** with our chips, recording the image and **decoding** the information, in a **millionth** of a second.	用我們的晶片,以電子的方式 記錄圖像並解讀資訊, 僅僅用了百萬分之一秒。[12:01]
We scan fast.	我們的掃描速度很快。[12:10]
Our system may be extraordinary at finding blood.	我們的系統在尋找血液時 可能非比尋常,[12:13]
And that's because blood **absorbs** red light and infrared light.	因為血會吸收紅光及紅外線光。[12:17]
Blood is red.	血是紅色的。[12:21]
Here's a **beaker** of blood.	這燒杯裡有血液。[12:23]
I'm going to show you.	我秀給你看。[12:25]
And here's our laser, going right through it.	這是我們的雷射射過去。[12:27]
It really is a laser, you can see it on the -- there it is.	這真的是雷射,你看,射進去了。[12:31]
In comparison to my **pound of flesh**, where you can **see the light** goes everywhere.	跟這肉相比, 光散射到各處。[12:33]
So let's see that again, blood.	我們再看一遍,血。[12:41]
This is really key: blood absorbs light, flesh scatters light.	這就是關鍵:血會吸光, 肉會把光散射掉。[12:44]
This is significant, because every tumor bigger than a **cubic** millimeter or two has five times the amount of blood as normal flesh.	這很重要, 因為每個大於一、二立方毫米的腫瘤 圍繞在它周圍的血液 是正常肉體的五倍。[12:50]

electronically: adv.电子地 **decoding:** n.[通信]解码;[计][通信]译码/v.破译;译解(decode的ing形式) **millionth:** n.百万分之一;第一百万/adj.百万分之一的;第一百万的 **absorbs:** v.吸收;吸引...的注意(absorb的第三人称单数形式) **beaker:** n.烧杯;大口杯 **pound of flesh:** 合乎法律的无礼要求 **see the light:** 出现;领悟 **cubic:** adj.立方体的,立方的

So with our system, you can imagine **detecting** cancers early, when **intervention** is easy, or tracking the size of your tumor as it grows or **shrinks**.	所以可以想像用我們的系統 早期發現癌細胞, 早期偵測容易治療, 或追蹤腫瘤的變大或縮小。[13:00]
Our system also should be extraordinary at finding out where blood isn't, like a **clogged artery**, or the color change in blood as it carries oxygen **versus** not carrying oxygen, which is a way to measure **neural** activity.	我們的系統尋找缺血流的部位 表現也應該不錯, 像是動脈阻塞方面的偵測, 或者血液中顏色的變化, 像是血液是否攜帶氧氣, 這是測量神經元活動的方法。[13:12]
There's a saying that "sunlight" is the best **disinfectant**.	有人說「太陽光」是最好的消毒劑。[13:28]
It's literally true.	真的是這樣。[13:33]
Researchers are killing **pneumonia** in lungs by shining light deep inside of lungs.	研究人員發現,透過照射太陽光 可以殺死肺深處的癌細胞。[13:35]
Our system could enable this noninvasively.	我們的系統能以非侵入式的方式 來達成這樣的效果。[13:41]
Let me give you three more examples of what this technology can do.	我再多舉三個例子來說明 這項科技可以為我們做些什麼。[13:45]
One: stroke.	第一:中風。[13:50]
www.XiYuSoft.com	**锡育软件**
There's two major kinds of stroke: the one caused by **clogs** and another caused by **rupture**.	中風的原因主要有兩個: 一個是腦血管堵塞, 另一個是腦血管破裂。[13:52]

detecting: n.检测;检定/v.发现;探知(detect的现在分词)/adj.探测的 **intervention:** n.介入;调停;妨碍 **shrinks:** vi.收缩;畏缩/vt.使缩小,使收缩/n.收缩 **clogged:** adj.阻塞的;堵住的/v.阻塞;妨碍(clog的过去分词) **artery:** n.动脉；干道；主流 **versus:** prep.对；与...相对；对抗 **neural:** adj.神经的;神经系统的;背的;神经中枢的 **disinfectant:** n.消毒剂/adj.消毒的 **pneumonia:** n.肺炎 **clogs:** n.木屐;木底鞋(clog的复数);阻碍/v.堵塞;阻碍(clog的三单形式) **rupture:** n.破裂;决裂;疝气/vi.破裂;发疝气/vt.使破裂;断绝;发生疝

If you can determine the type of stroke within an hour or two, you can give medication to massively reduce the damage to the brain.	如果你能在一到兩個小時內 判定是哪一種類型的中風, 就可以服用正確的藥物, 大大地減少腦部受損的危險。[13:58]
Get the drug wrong, and the patient dies.	吃錯藥, 病人就會完蛋。[14:08]
Today, that means access to an MRI **scanner** within an hour or two of a stroke.	意思是現今中風後的一至二小時內 得要用核磁共振儀進行掃描。[14:12]
Tomorrow, with **compact**, portable, **inexpensive** imaging, every ambulance and every clinic can decode the type of stroke and get the right **therapy** on time.	未來,有了這個小巧、可攜帶, 又不貴的影像成型技術, 每一台救護車及每家醫院 都能及時判斷中風的種類, 並採取正確的醫治方式。[14:18]
(Applause) Thanks.	（掌聲） 謝謝。[14:30]
Two: **two-thirds** of **humanity lacks** access to medical imaging.	第二: 這世上還有三分之二的人 無法取得醫學顯影的醫療服務。[14:35]

Compact, portable, inexpensive medical imaging can save **countless** lives.	這小巧、可攜帶又不貴的 醫學影像成型技術能拯救無數性命。[14:43]
And three: brain-computer communication.	第三: 人腦與電腦的溝通。[14:49]
I've shown here **onstage** our system focusing through skull and brain to the diameter of the smallest neuron.	我在台上已向各位展示 我們的系統可以穿透頭骨精準地觀測到最小的神經元。[14:53]
scanner: n.[计]扫描仪;扫描器;光电子扫描装置 **compact:** n.合同,契约;小粉盒/adj.紧凑的,紧密的;简洁的/vt.使简洁;使紧密结合 **inexpensive:** adj.便宜的 **therapy:** n.治疗，疗法 **two-thirds:** n.三分之二/三分之二的/三分之二地 **humanity:** n.人类；人道；仁慈；人文学科 **lacks:** vt.缺乏;不足;没有;需要/vi.缺乏;不足;没有/n.缺乏;不足 **countless:** adj.无数的;数不尽的 **onstage:** adj.台上的;台上演出的/adv.上台;上场	
Using light and sound, you can **activate** or **inhibit** neurons, and simultaneously, we can match **spec** by **spec** the resolution of an fMRI scanner, which measures oxygen use in the brain.	你可以利用光及聲音 來刺激或抑制神經元的活動; 同時,我們的規格不輸給 功能磁共振成像掃描儀, 可以用來測量腦部的氧氣消耗量。[15:01]
We do that by looking at the color change in the blood, **rather than** using a two-ton magnet.	我們藉由觀察血液的顏色變化, 不用一台兩噸重的磁鐵儀器。[15:14]
So you can imagine that with fMRI **scanners** today, we can decode the imagined words, images and dreams of those being scanned.	現今用共振成像掃描儀, 想像我們的技術能解碼 掃描到的文字、圖片、夢境。[15:21]
We're working on a system that puts all three of these capabilities into the same system -- neural read and write with light and sound, while simultaneously **mapping** oxygen use in the brain -- all together in a **noninvasive** portable that can enable brain-computer communication, no **implants**, no surgery, no optional brain surgery required.	我們正在把這三個功能 結合在同一個系統裡, 利用光與聲音來讀寫神經元, 同時掃描腦中的含氧量, 全部集合在非侵入性的可攜裝置裡, 可促成人腦與電腦的溝通, 不需植入、不需手術, 不用考慮腦部開刀這選項。[15:33]
This can do **enormous** good for the two billion people that **suffer** globally with brain disease.	這可以為全球兩百萬個深受[15:55]
activate: vt.刺激;使活动;使活泼;使产生放射性/vi.激活;有活力 **inhibit:** vt.抑制;禁止 **spec:** n.投机;说明书;细则 **rather than:** 而不是;宁可...也不愿 **scanners:** n.[电子]扫描器(scanner的复数) **mapping:** v.绘图;筹划(map的ing形式)/n.地图;绘图;[数]映像 **noninvasive:** adj.非侵袭的;非侵害的 **implants:** 移植物;埋植剂(implant的复数)/v.灌输(implant的第三人称单数) **enormous:** adj.庞大的，巨大的；凶暴的，极恶的 **suffer:** vt.遭受；忍受；经历/vi.遭受，忍受；受痛苦；经验；受损害/	
(Applause) People ask me how deep we can go.	（掌聲） 人們問我能看到多深。[16:03]
And the answer is: the whole body's in reach.	答案是:全身。[16:10]
But here's another way to look at it.	這裡有另一個看待的方式。[16:13]
(Laughter) My whole head just lit up, you want to see it again?	（笑聲） 剛剛我整顆頭亮了, 想要再看一遍嗎? [16:20]
Audience: Yes!	觀眾:要！[16:24]
(Laughter) MLJ: This looks scary, but it's not.	（笑聲） MLJ:這看起來很可怕 但並不可怕。[16:25]
What's truly scary is not knowing about our bodies, our brains and our diseases so we can effectively treat them.	真正可怕的是不懂我們的身體、 我們的腦、我們的疾病, 以致未能有效地治療。[16:30]
This technology can help.	這項科技可以幫助我們。[16:37]
Thank you.	謝謝各位。[16:39]
(Applause) Thank you.	（掌聲） 謝謝。[16:40]
(Applause)	（掌聲）[16:47]