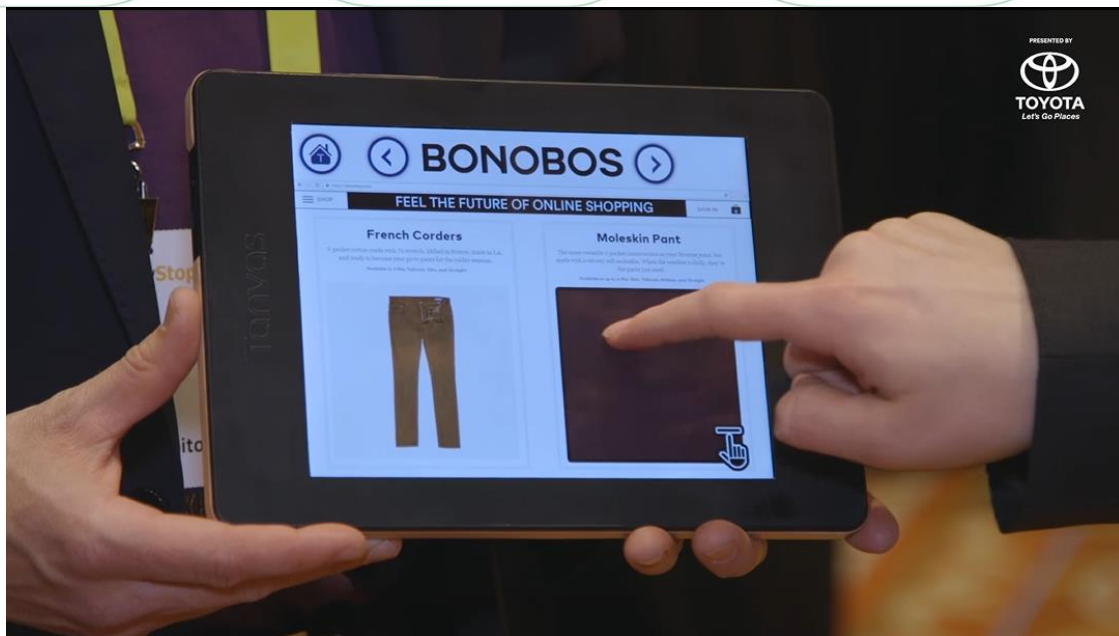


多点触觉触控屏、系统及制作方法

未来安全研究院 张伟
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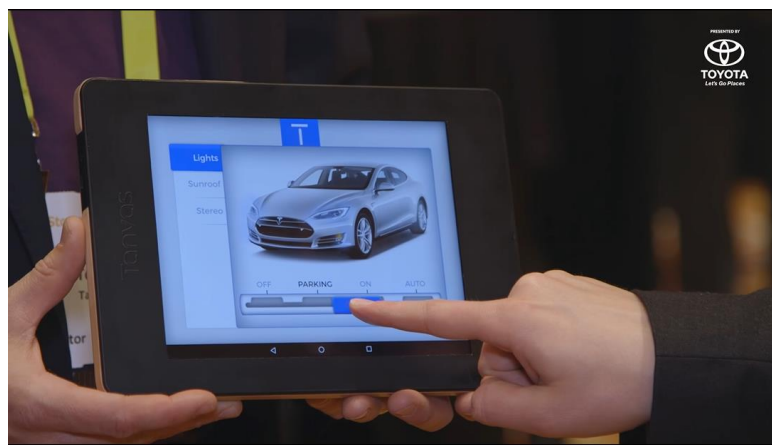
技术背景



新型购物体验 触摸面料/纹理



不同纹理反馈



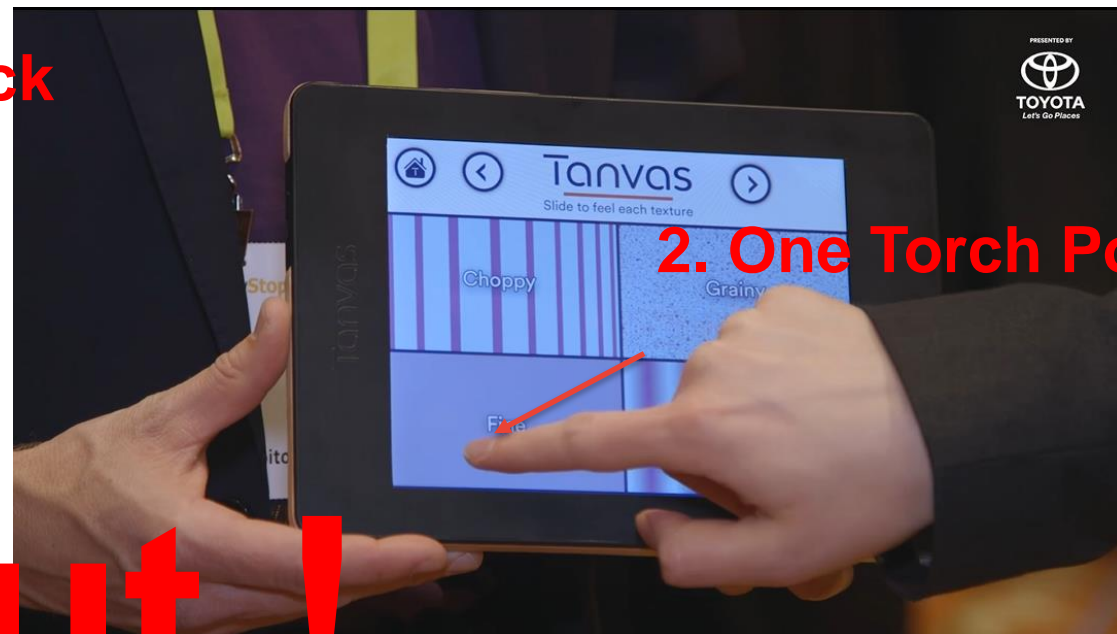
车载类：未来的车内装饰及驾驶舱



物体表面纹理特征反馈



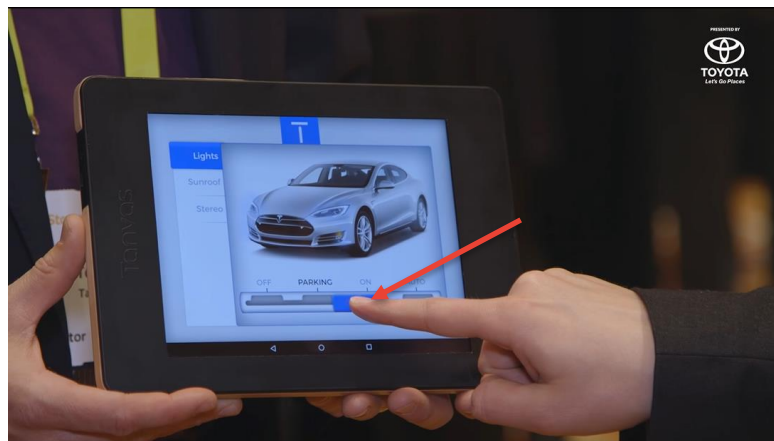
控键操作反馈



But!

新型购物体验 触摸面料/纹理

不同纹理反馈



机械控制器操控反馈



物体表面纹理特征反馈



控键操作反馈

动图需要放映PPT查看效果



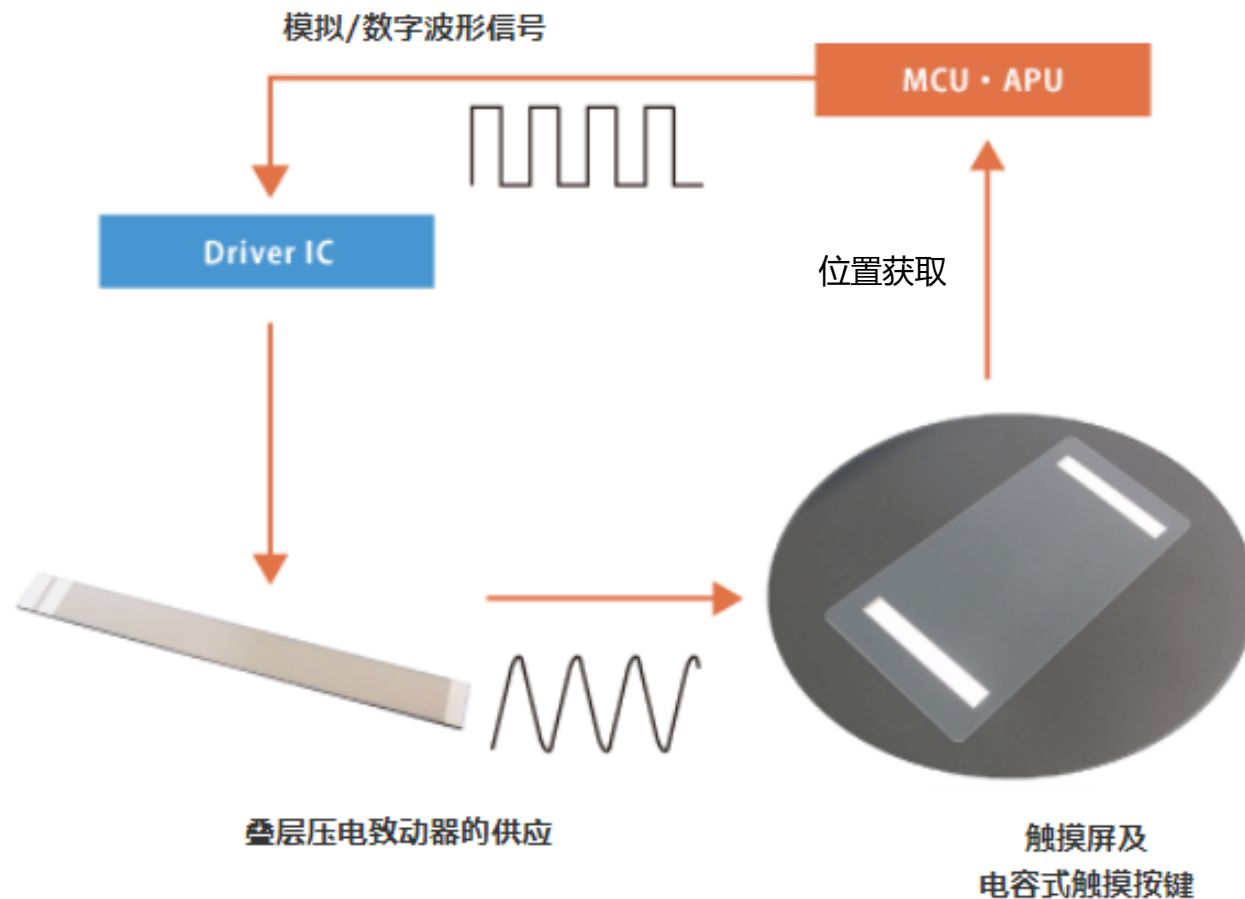
角色伤害反馈

驾驶地面平整度反馈

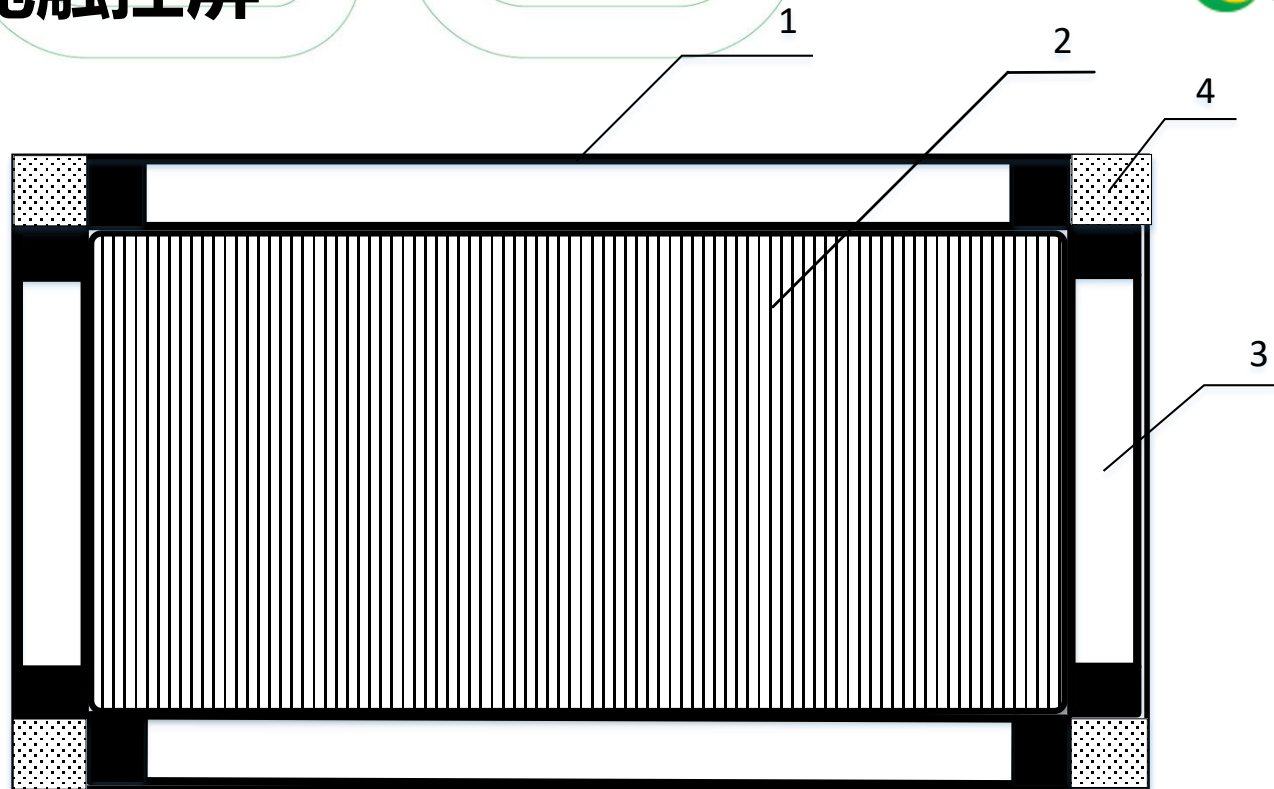


多点触控，独立反馈

本公开发明涉及一种多点触觉触控屏、系统及其制作方法，将射术型叠层压电振动片两两一组紧贴于显示屏下部靠边处，通过**MCU/APU**等控制器输出数字信号波形，压电制动器因施加电压而产生形变（逆压电效应），改变正交放置输出波形的相位，延垂直、水平方向的各两列相干波在相向方向上传播，玻璃面板上形成驻波。如在此情况下触摸面板，动摩擦就会发生变化，从而可以感觉到“粗糙感”。



多点触觉触控屏



俯视图



侧视图

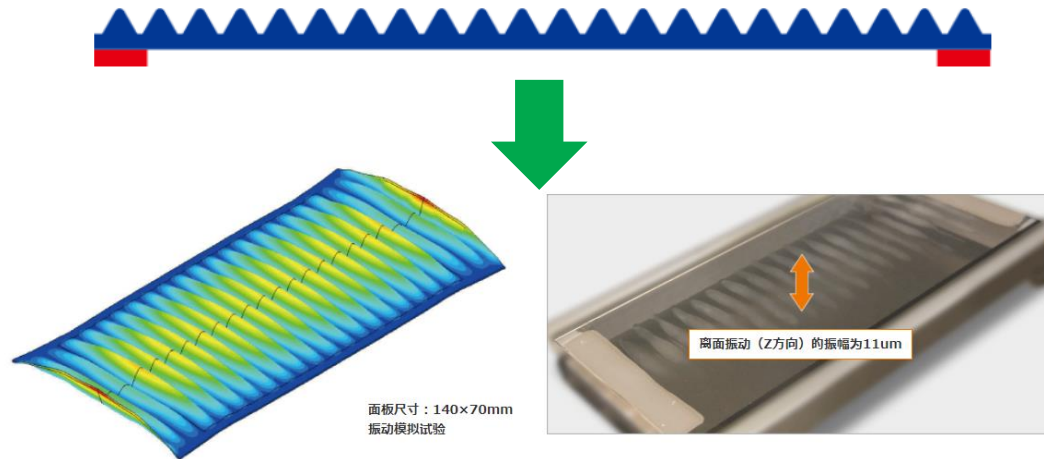


正视图

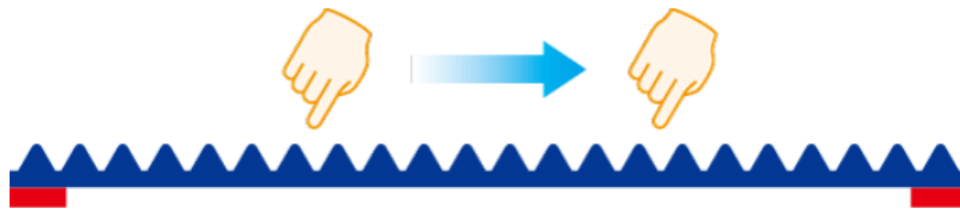
- 1 - 透明玻璃面板、结晶性树脂面板
- 2 - 电容式触控显示屏
- 3 - 射术型叠层压电振动片
- 4 - 压电制动器电极接线端

触觉触控屏原理

在面板背面的两端贴附压电致动器
利用超声波频率驱动时，会在面板表面激起驻波



致动器
利用超声波频率驱动表面振动



手指触摸面板表面时，可以感受到粗糙感
这一触感会根据驻波的振幅等因素发生变化

两正交相干波形成驻波

水平方向上,

$$\begin{cases} z_1 = \sin(x - t) & 0 < t < 10 \\ z_2 = \sin(\cos(\theta)) * x + \sin(\theta) * y - t & \theta = (\pi/12) * k, k = 0, 1, 2, \dots, 12 \end{cases} \quad \text{式 (1)}$$

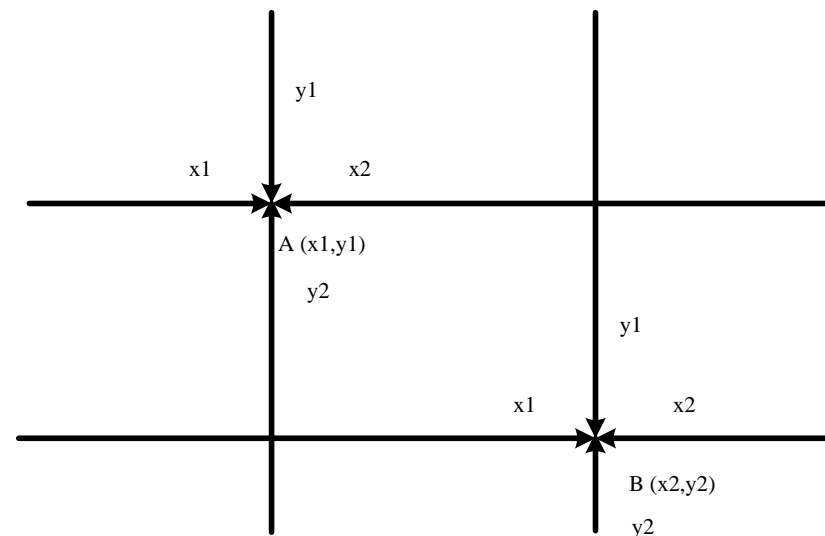
$$\begin{aligned} z &= z_1 + z_2 \\ &= \sin(x - t) + \sin(\cos(\theta)x + \sin(\theta)y - t) \\ &= 2 \cos\left(\frac{1}{2}x(\cos\theta - 1) + \frac{1}{2}y\sin\theta\right) \sin\left(\frac{1}{2}x(\cos\theta + 1) + \frac{1}{2}y\sin\theta - t\right) \end{aligned} \quad \text{式 (2)}$$

其中, z_1 、 z_2 表示两列空间上的相干波, t 表示初相位, θ 表示相位值, π 表示圆周率, k 表示相位值的范围 $0 \sim \pi$ 。

垂直方向上,

$$\begin{cases} z_1 = \sin(y - t) & 0 < t < 10 \\ z_2 = \sin(\cos(\theta)) * y + \sin(\theta) * x - t & \theta = (\pi/12) * k, k = 0, 1, 2, \dots, 12 \end{cases} \quad \text{式(3)}$$

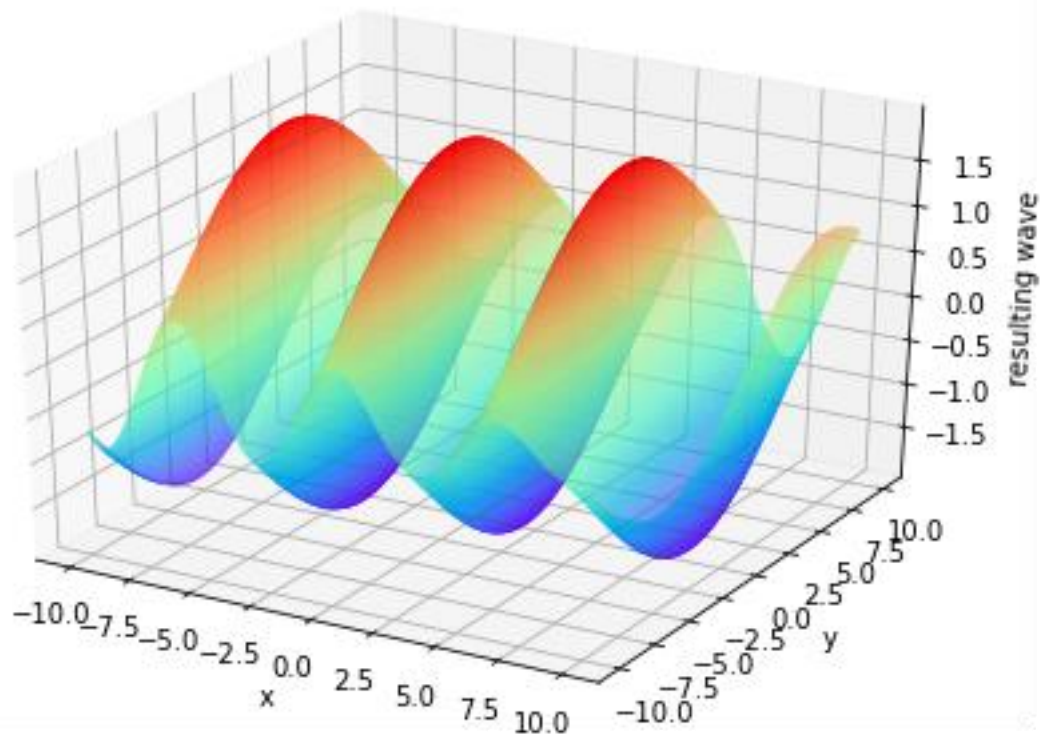
$$\begin{aligned} z &= z_1 + z_2 \\ &= \sin(y - t) + \sin(\cos(\theta)x + \sin(\theta)y - t) \\ &= 2 \cos\left(\frac{1}{2}y(\cos\theta - 1) + \frac{1}{2}x\sin\theta\right) \sin\left(\frac{1}{2}y(\cos\theta + 1) + \frac{1}{2}x\sin\theta - t\right) \end{aligned} \quad \text{式 (4)}$$



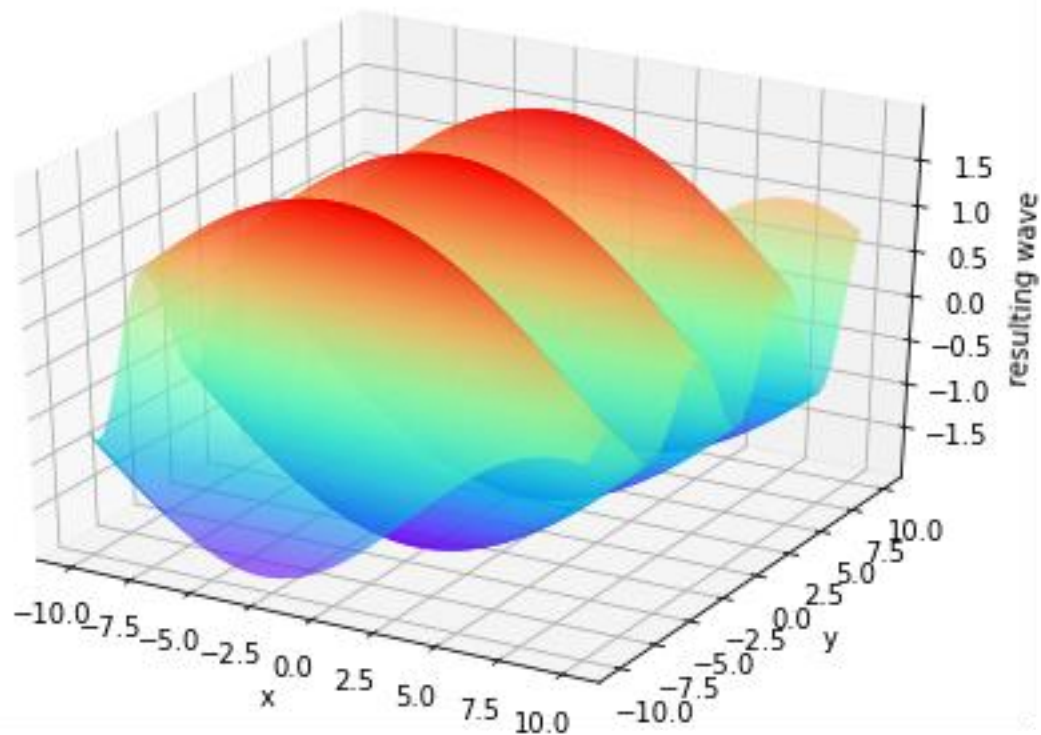
两正交相干波形成驻波

(相位 $\theta=15^\circ$)

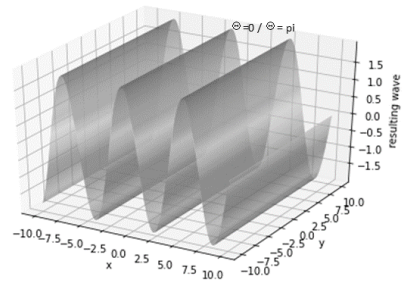
水平方向



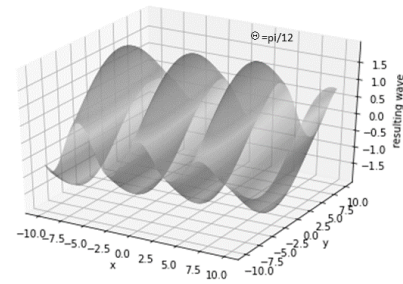
竖直方向



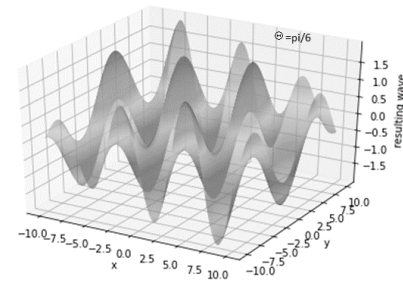
仿真图 (相同振幅、不同相位, 间隔 15°)



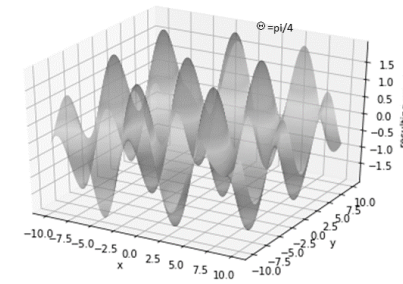
(1)



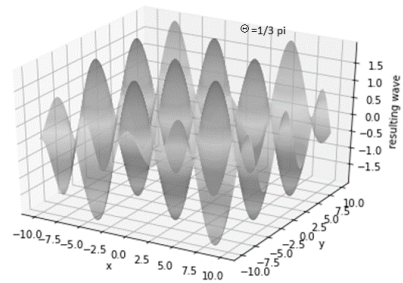
(2)



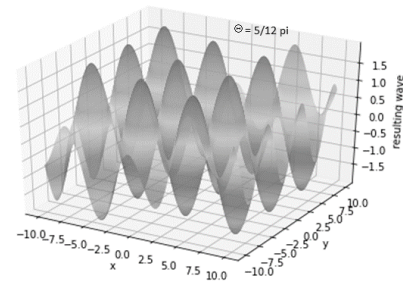
(3)



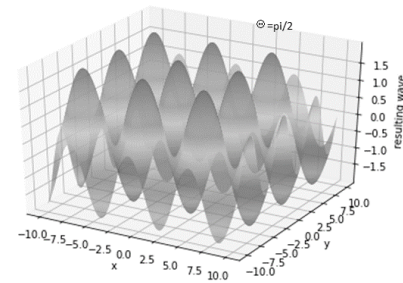
(4)



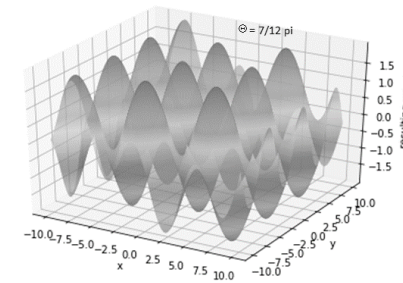
(5)



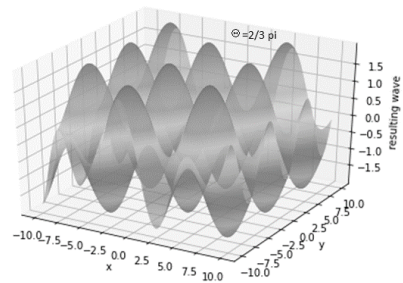
(6)



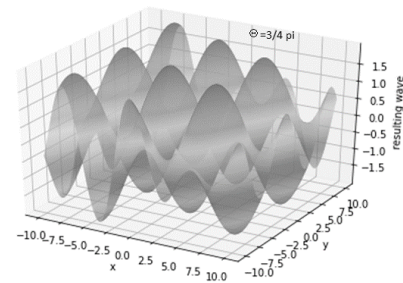
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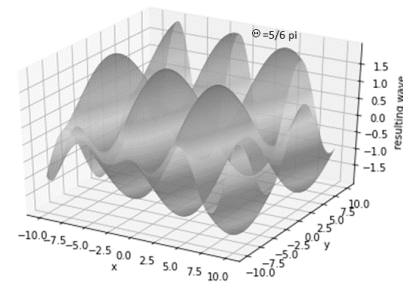
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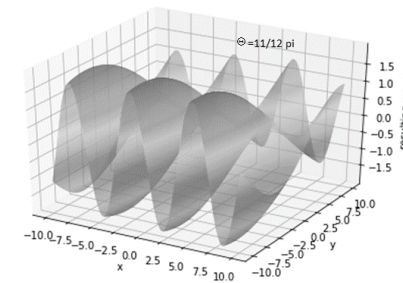
(9)



(10)



(11)

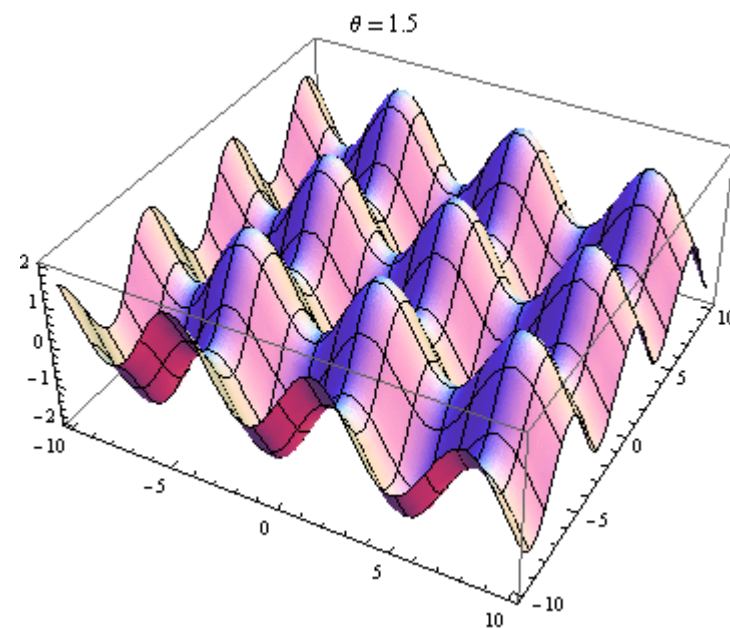
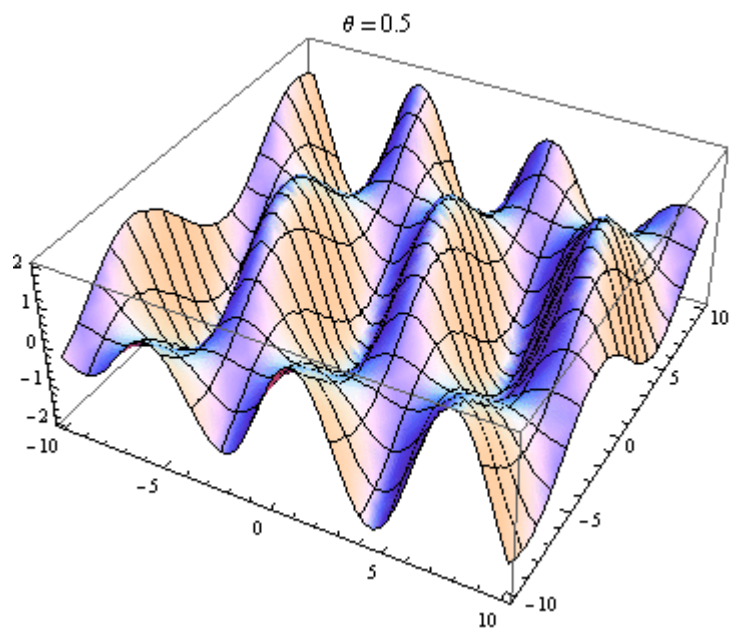
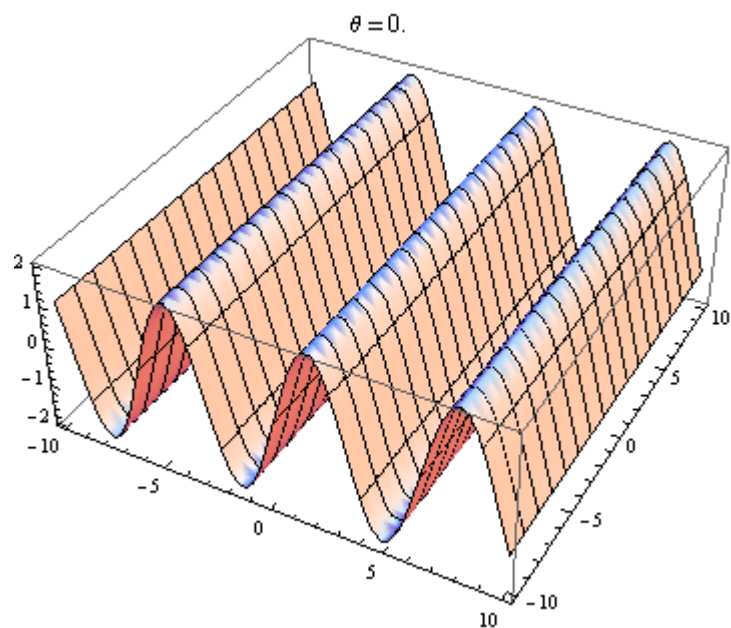


(12)

两正交相干波形成驻波

(相同振幅、不同相位)

动图需要放映PPT查看效果

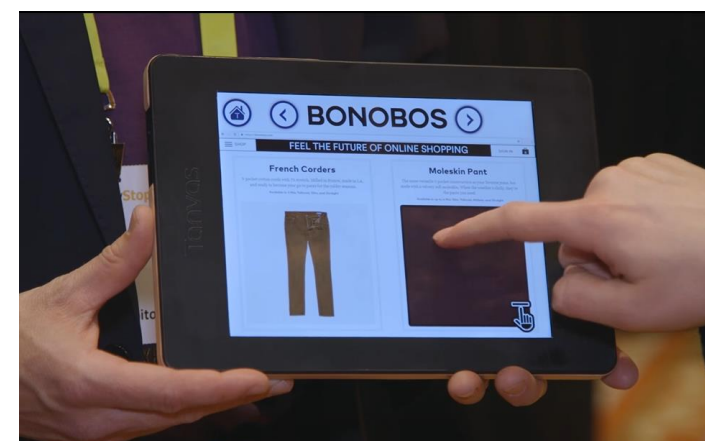
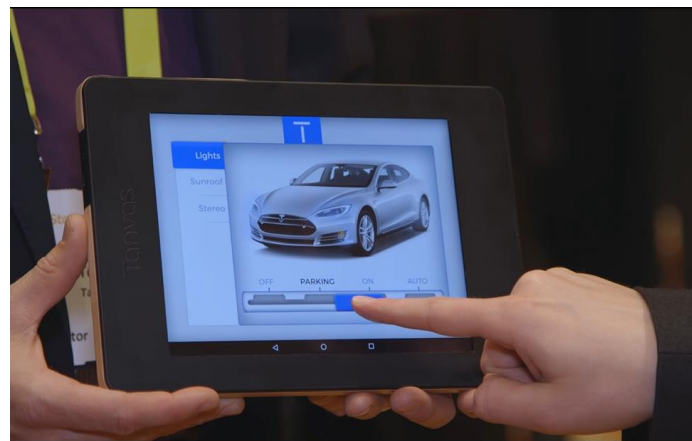


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本发明带来的有益效果



- 1 后视镜（可使用摄像头）控制面板
- 2 方向盘控制面板
- 3 中控台控制面板
- 4 触摸板



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Thanks for Your Listening

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