



高動態(HDR)影像攝影技術

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大綱

- 高動態影像簡介
- 視覺反差模式
- 高動態影像和環場影像
- 圖例
- 結論

影像拍攝的問題

- 在光線差異過大的區域，會造成亮部或暗部細節的遺失





高動態的特性

- High Dynamic Range (HDR) of scene luminance
 - 1,000,000 cd/m² 人眼錐狀細胞可反應的極限
 - 100,000 cd/m² 晴朗的陽光下
 - 500 cd/m² LCD TV白點
 - 50 cd/m² 室內環境
 - 0.01 cd/m² 月光
 - 0.001 cd/m² 星光

 - 1,000,000,000:1 (10⁹:1)
- Low Dynamic Range (LDR) output media
 - 印表機 100:1
 - LCD螢幕 1000:1 ~ 500:1
- 人眼視覺可適應高動態域的亮度差異

早期的高動態研究

Time	Names	Type	Characteristics
1984	Miller	Global	Mapping by constant brightness ratio
1993	Tumblin and Rushmeier	Global	Mapping brightness value in suprathreshold level
1993	Chiu	Local	First spatially-varying operator
1994	Ward	Global	Match contrast sensitivity in photopic threshold
1996	Ferwerda	Global	Match contrast sensitivity in scotopic visibility
1997	Ward Larson	Global	Histogram mapping
1998	Pattanik	Local	Multiscale for threshold and suprathreshold vision
2002	Reinhard	Local	Photographic tone mapping
2002	Ashikhmin	Local	Mapping by local contrast equivalence
2002	Durand and Dorsey	Local	Fast bilateral filter
2002	Fattal	Local	Attenuating large gradient for compression
2002	Kotera	Local	Adaptive scale-gain MSR Retinex
2002	Fairchild	Local	iCAM image appearance
2005	Reinhard and Devlin	Local	Photoreceptor model
2007	Wang	Local	Integrated surround Retinex
2007	Kuang	Local	iCAM06 image appearance



彩色視覺的策略

■ Berns:

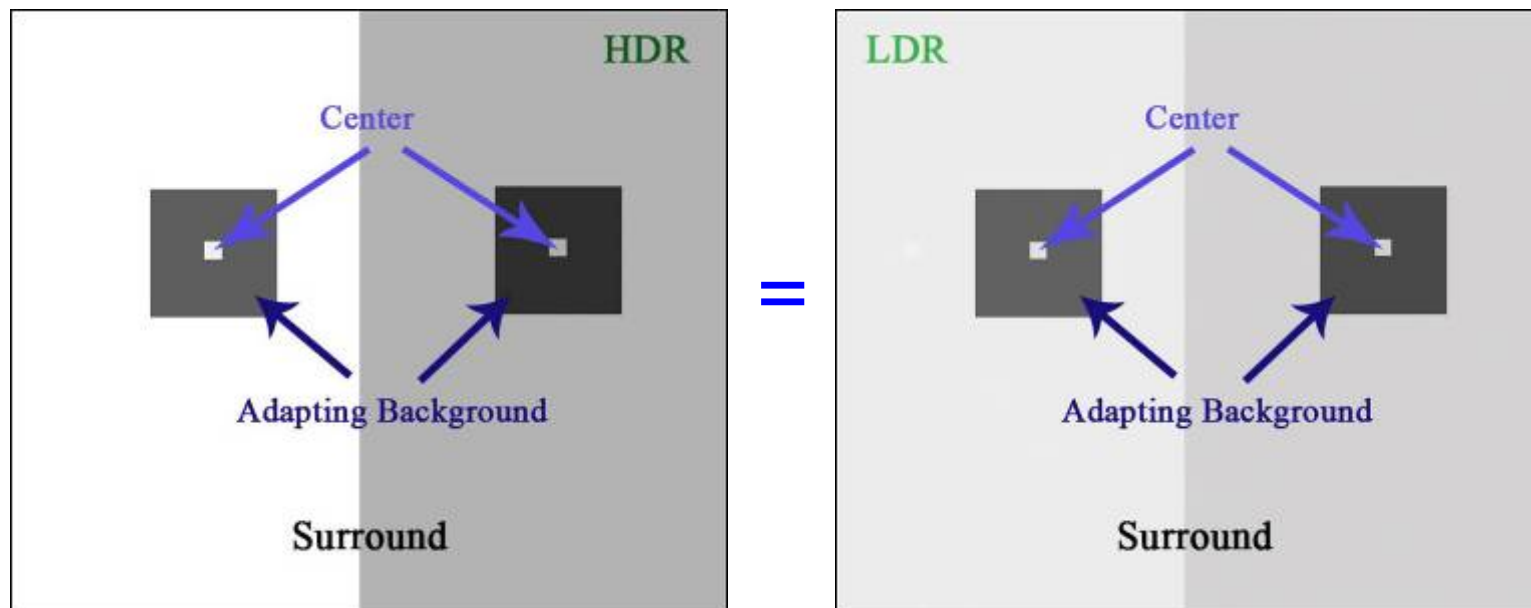
- Preferred reproduction (Pleasing-type)
- Exact match reproduction

Exact Match	Media Type	Example
Spectral (invariant)	Similar	Proofing, multi-ink printing
Colorimetric (conditional)	Similar	Color copying, photograph-to-print
<u>Color Appearance</u>	Dissimilar	Real-life-to-photograph , CRT-to-print

等價的視覺反差

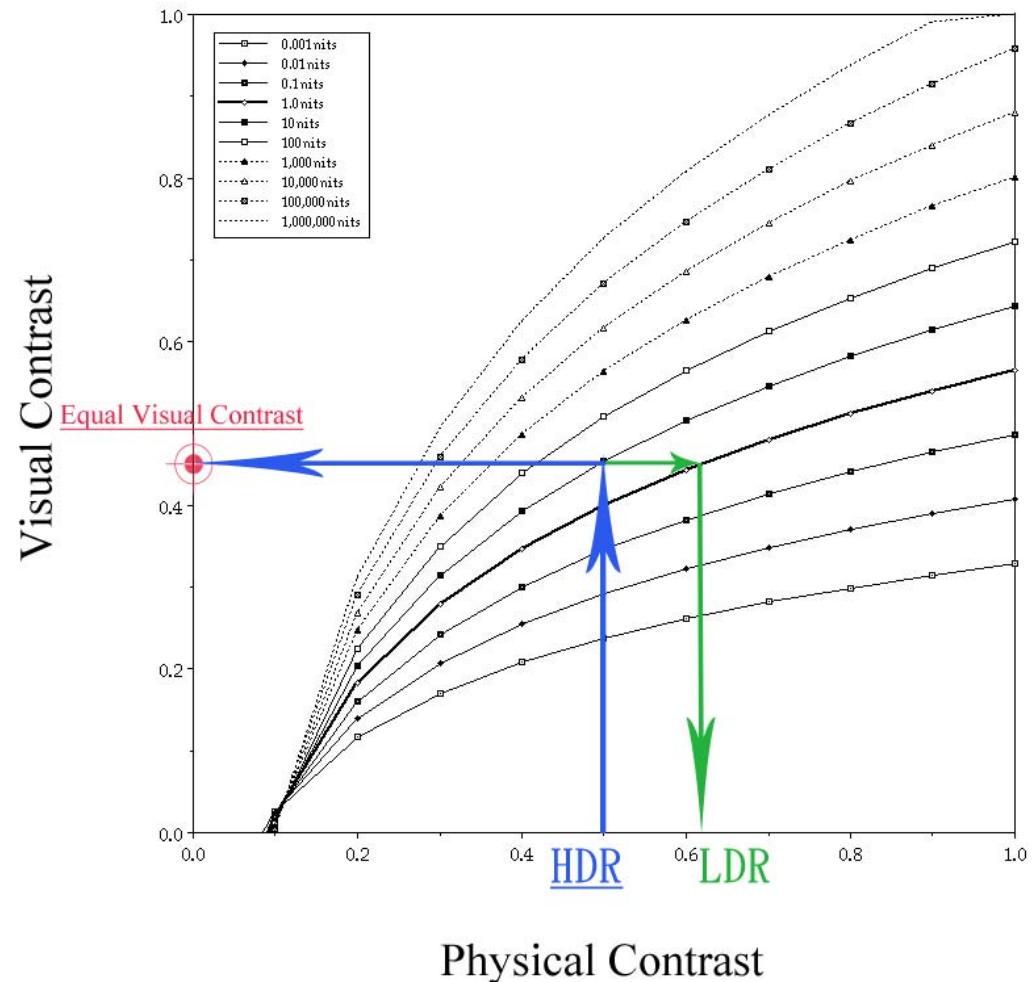
- $\text{Image} = \Sigma \text{Center}(x, y)$
- $\text{Physical Contrast}(x, y) = \text{Center}(x, y) / \text{Background}(x, y)$
- $F(\text{HDR Physical Contrast}(x, y)) = F(\text{LDR Physical Contrast}(x, y))$
- $(\text{Visual Contrast}(x, y))_{\text{HDR}} = (\text{Visual Contrast}(x, y))_{\text{LDR}}$

HDR Physical Contrast	\rightarrow	HDR Visual Contrast
		=
LDR Physical Contrast	\leftarrow	LDR Visual Contrast



視覺反差對應

- HDR Physical Contrast = $\text{Center}(x,y)/\text{Background}(x,y)$
- Visual Contrast = $f(\text{HDR Physical Contrast, Adapting HDR luminance})$
- LDR Physical Contrast = $\text{Inverse } f(\text{Visual Contrast, Adapting LDR luminance})$
- LDR $\text{Center}(x,y) = \text{LDR Physical Contrast} * \text{LDR Background}(x,y)$
- LDR $\text{Center}(x,y)$ is the reproduced image (x,y)

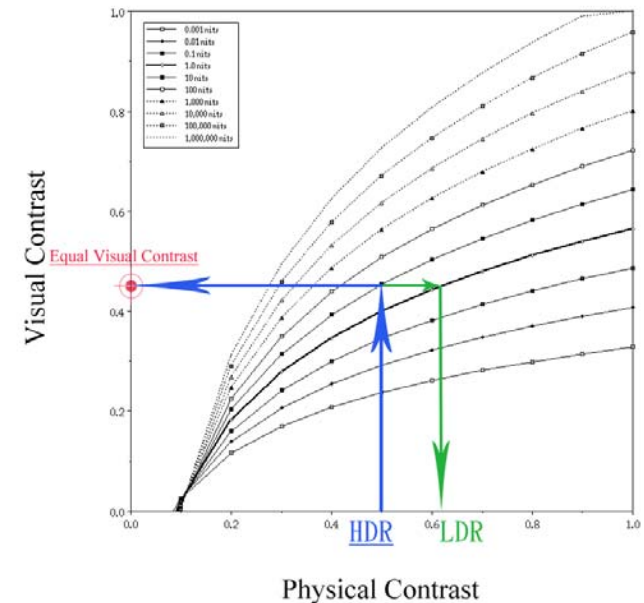
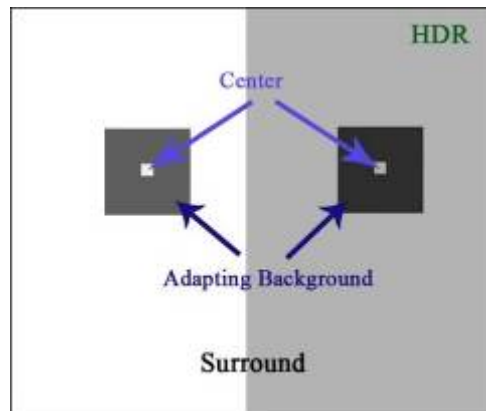


用於高動態的等價視覺反差模式

- *By having the same RPVC values to achieve the perceived visual contrast mapping for HDR*

- $$RPVC_i\left(\frac{S_C(x, y)}{S_B(x, y)}, L_B(x, y)\right) = RPVC_i\left(\frac{S'_C(x, y)}{S'_B(x, y)}, L'_B(x, y)\right)$$

- *To compute the unknown $S'_C(x, y)$*





高動態影像和環場影像

- 高動態影像製作
 - 影像拍攝
 - 合成高動態影像
 - 影像處理
 - 高動態影像
- 環場影像實例



EV=+1



EV=0



EV=-1

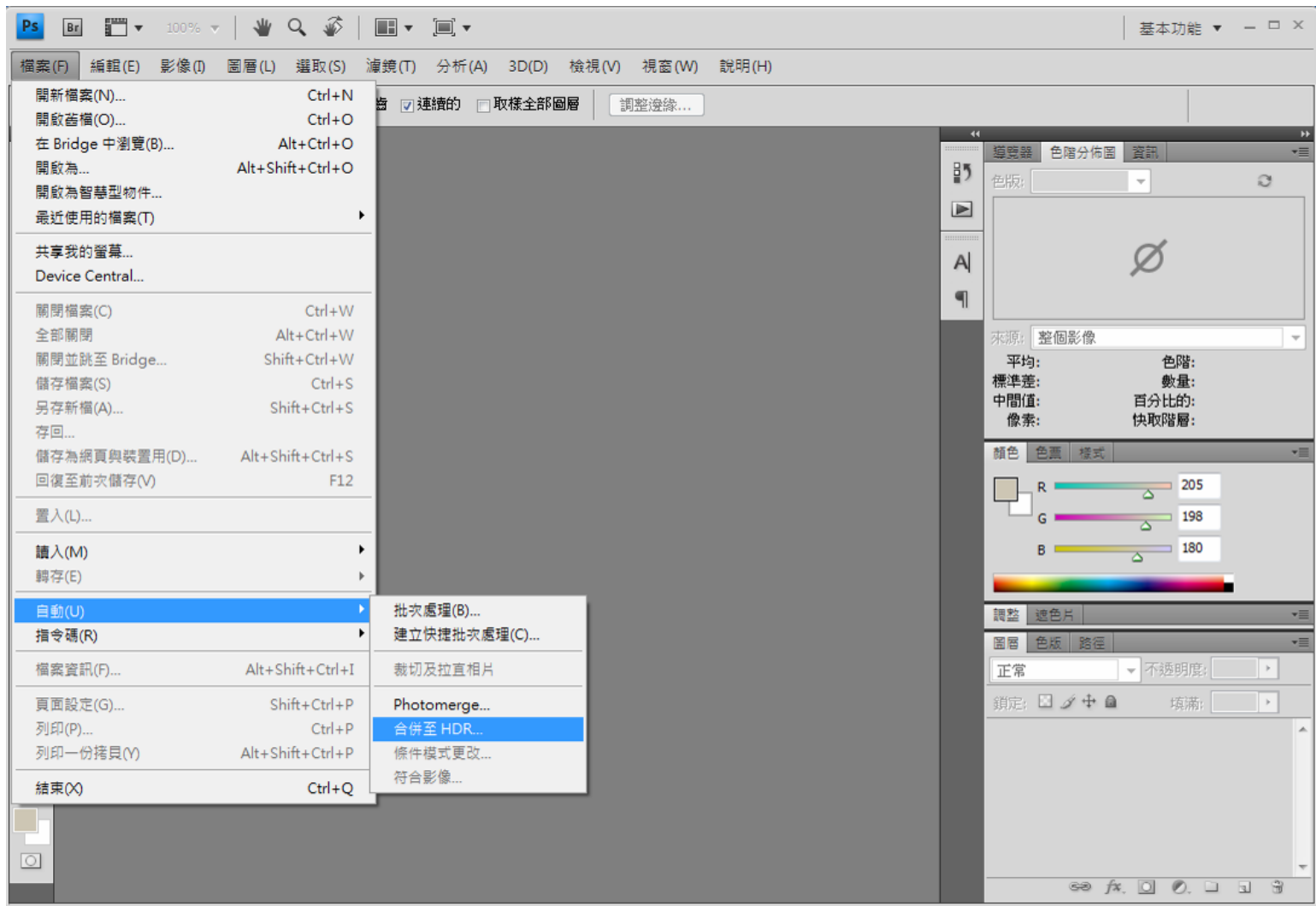


合并成 HDR → Tomemapping →

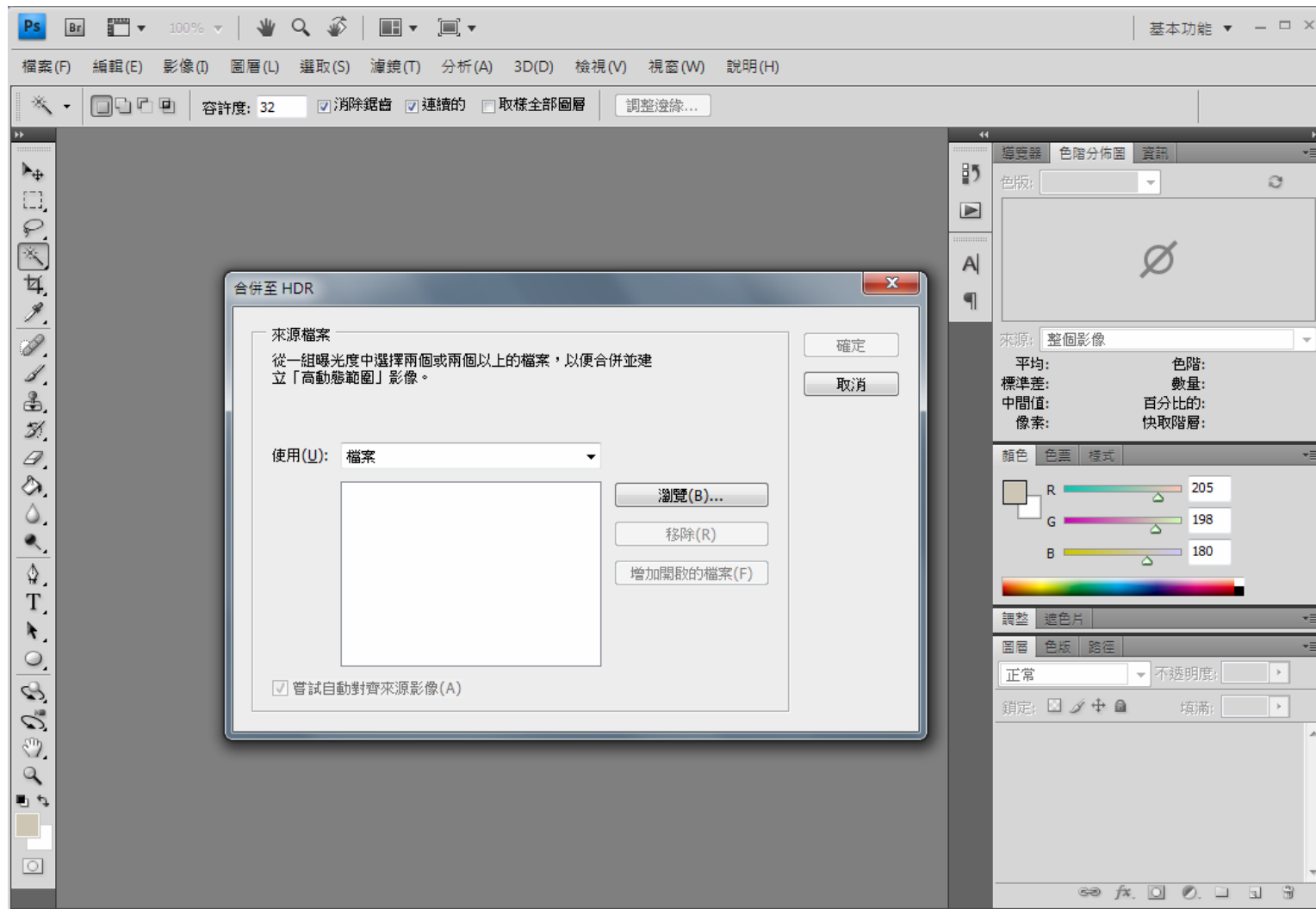


包圍式曝光設定

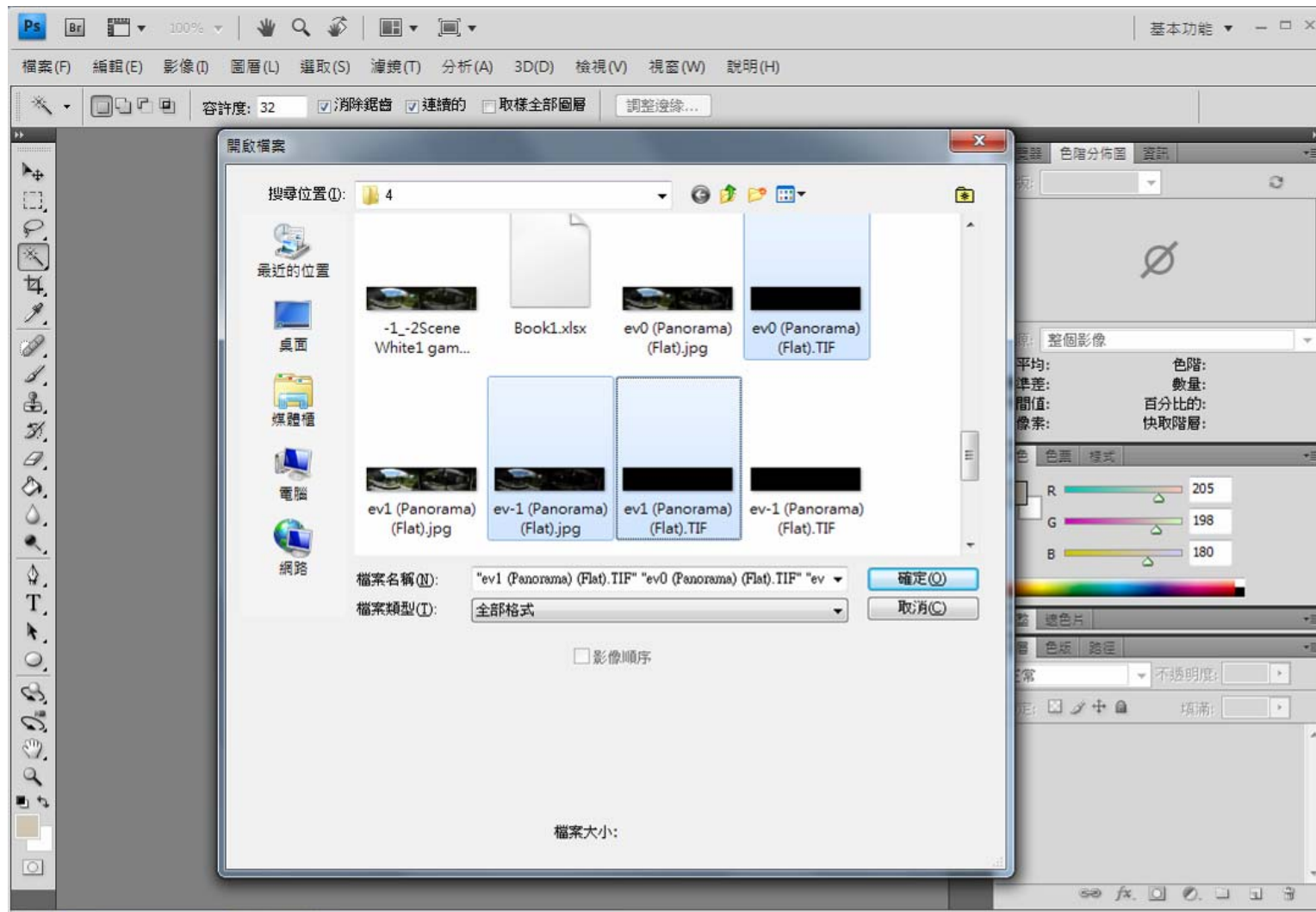




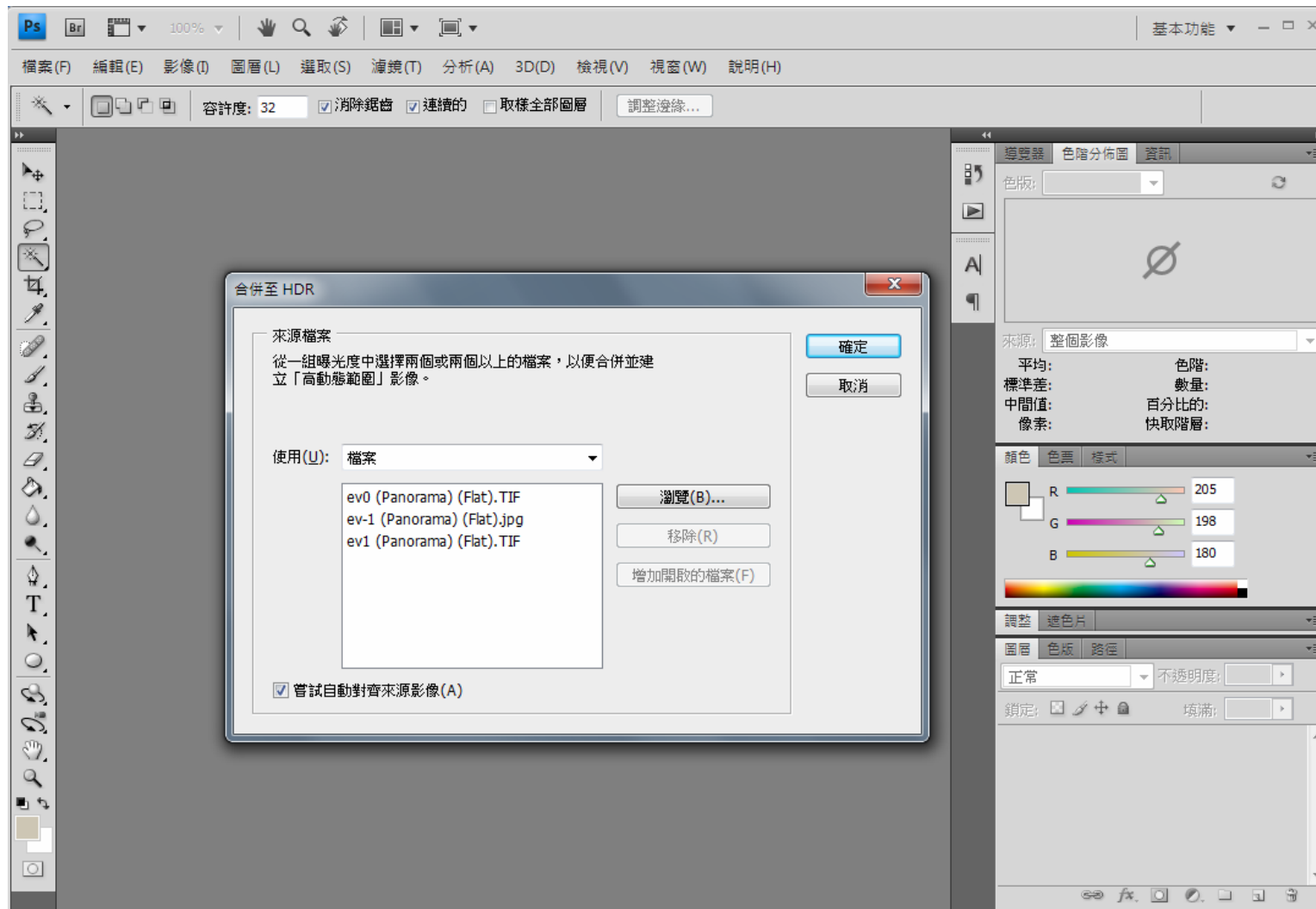
開啟Photoshop 點選檔案->自動->合併至HDR



點選瀏覽，選擇檔案兩張（含）以上的檔案或資料夾



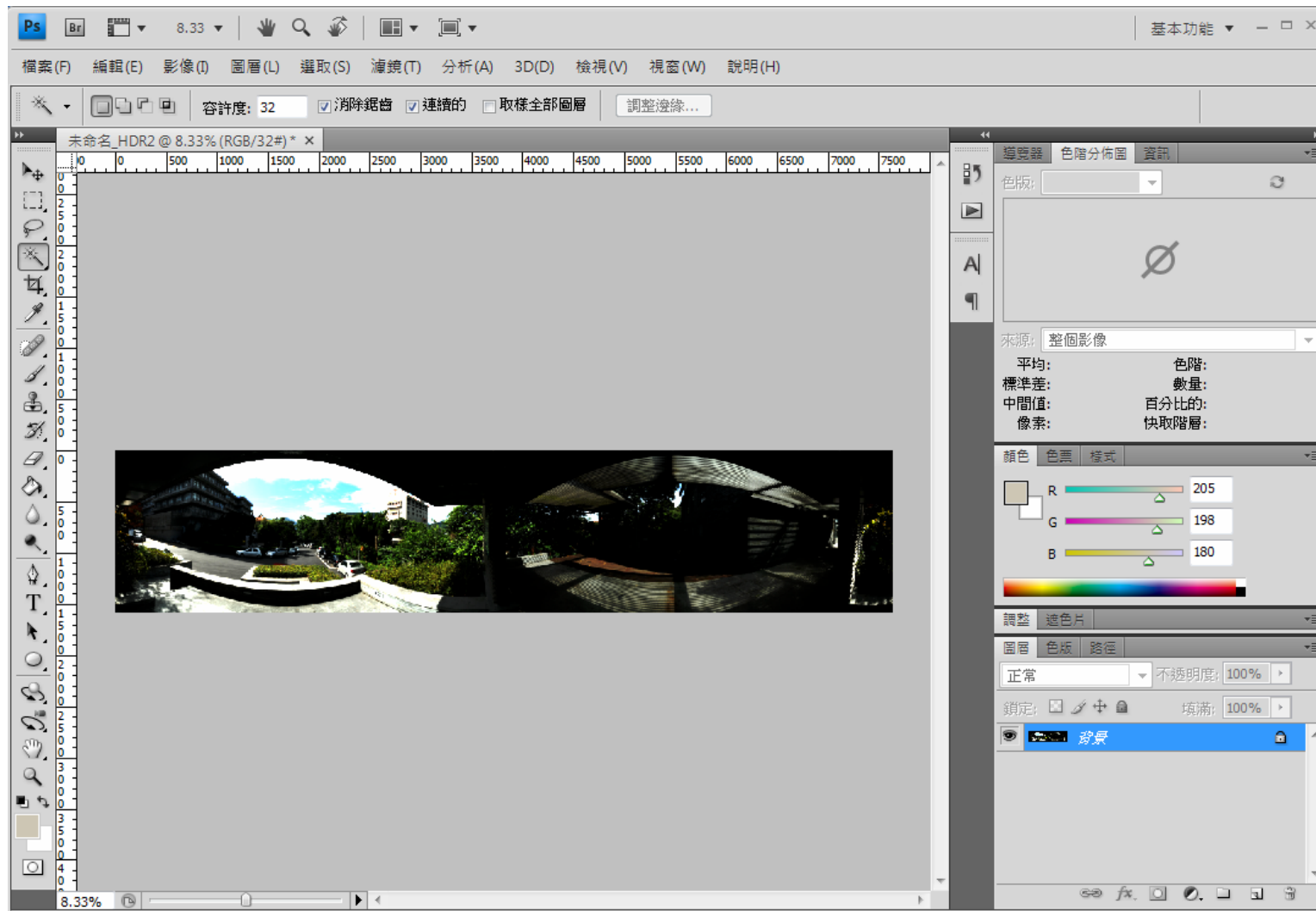
開啟所選擇的檔案



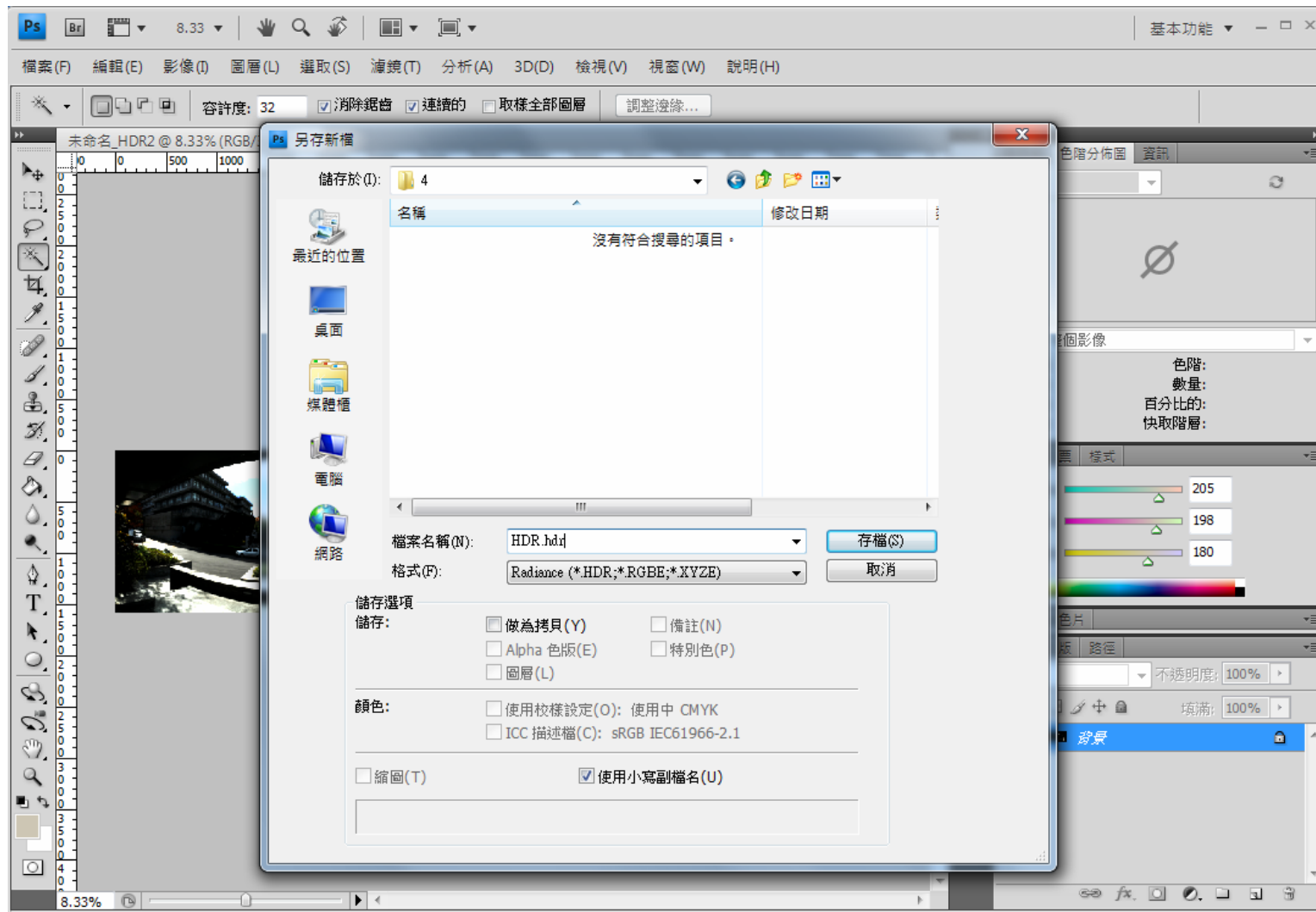
點確定鍵執行合併



選擇確定以產生HDR

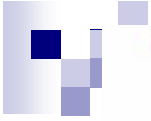


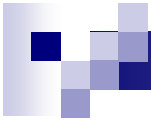
合併後的HDR影像會顯示在工作區中



選擇檔案->另存新檔，在檔案格式中選擇Radiance，即產生HDR檔案

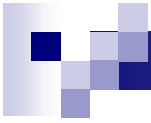


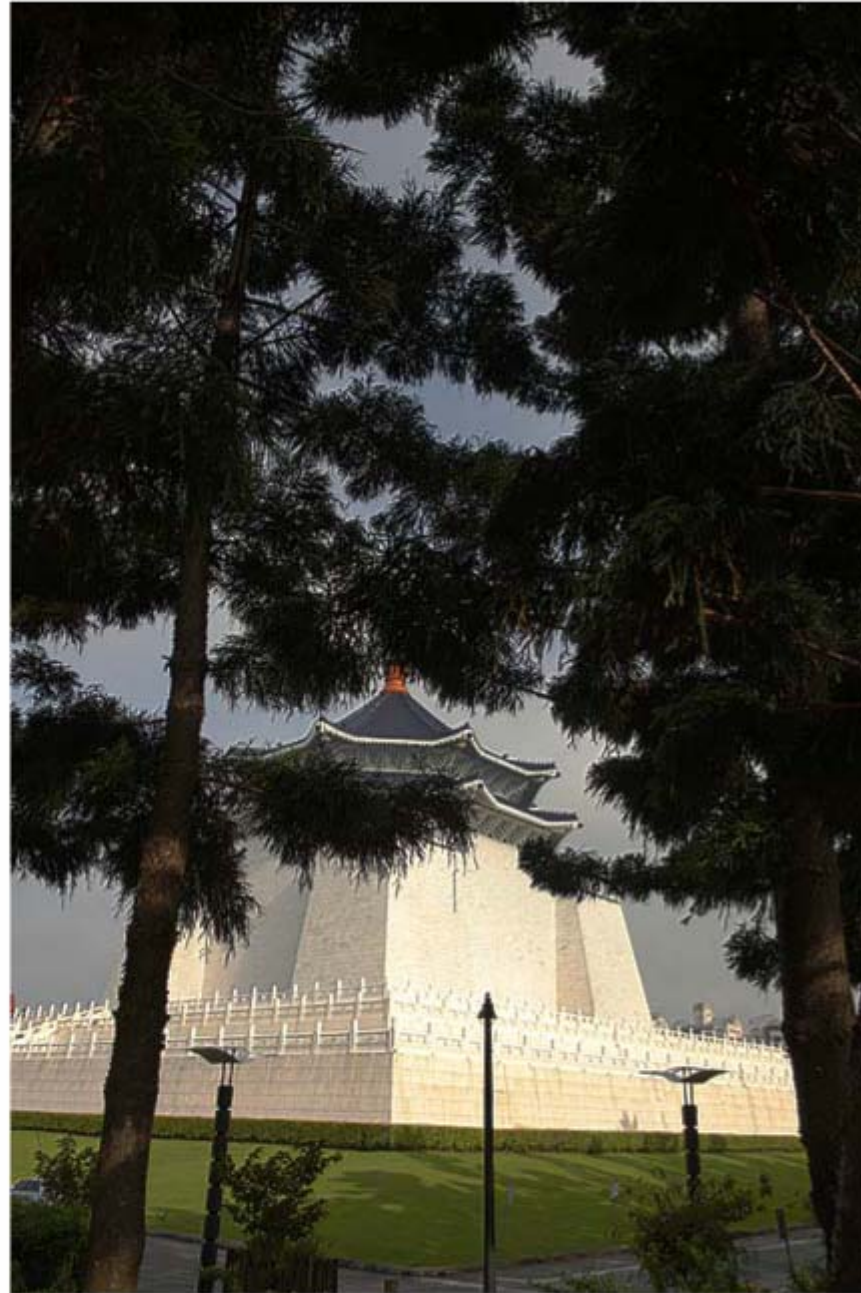


























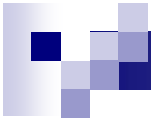


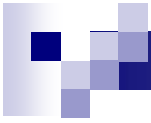




非高動態影像的環景影像









結論

- 高動態影像技術可以解決極端光線條件下曝光過度與曝光不足的問題
- 在環景影像中常見的光差過大問題可有效呈現接近人眼的影像
- 對建築攝影的應用潛力無窮