

Prof. Jiaya Jia
(賈佳亞)
The Chinese University of Hong Kong
(香港中文大學)

A NEW BLUR REMOVAL TECHNIQUE (新圖像去模糊技術)

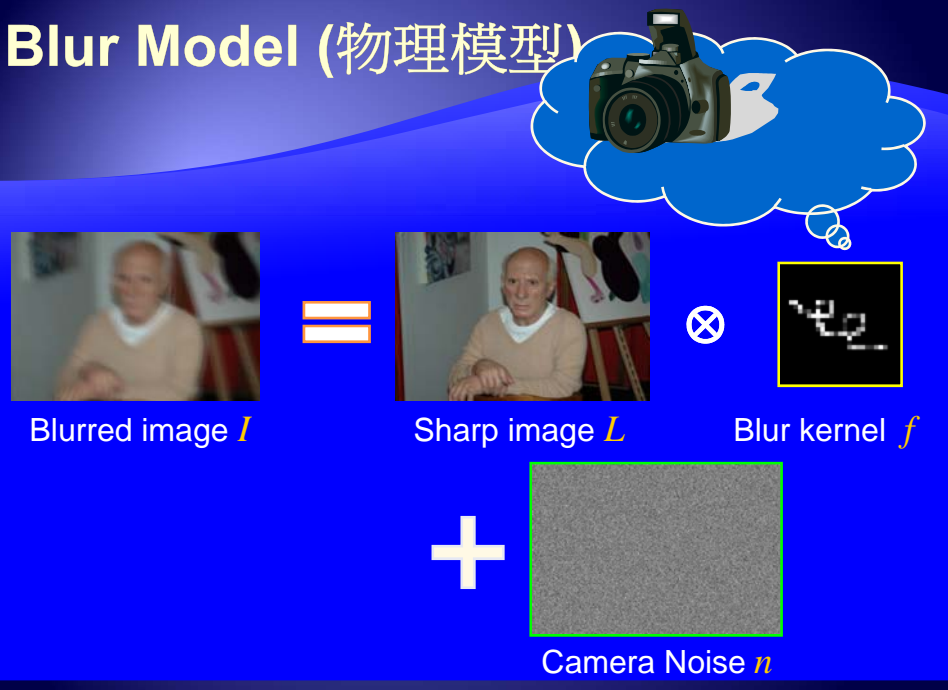
The Problem (問題產生)



Problem History (歷史)

- ◆ It is a very old and traditional problem in the image processing area.
- ◆ It is based on a conjecture that images can be restored even after blur.
- ◆ But in the past 20-30 years, there was no much progress in solving the problem.

Blur Model (物理模型)



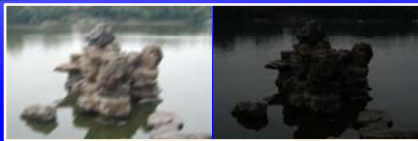
Previous Work (1) (以前方法)

Hardware solutions:



Previous Work (2) (以前方法)

Multi-frame solutions:



[Jia et al. 2004]



[Rav-Acha and Peleg 2005]



[Petschnigg et al. 2004]



[Yuan et al. 2007]

The Problems (實質問題)

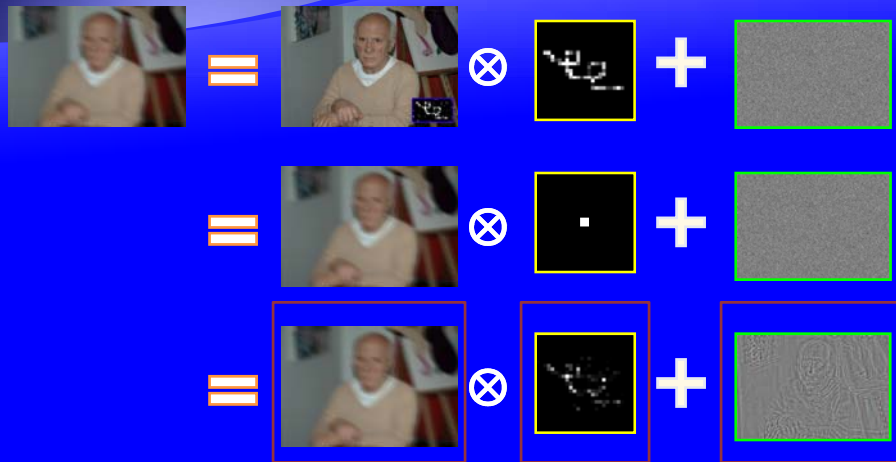


Blind deconvolution

An Example







Challenges (2)




基於概率模型的迭代優化





Iteration n
(converge)




 =  \otimes  + 








Iteration 1

 =  \otimes  + 








Iteration 2

 =  \otimes  + 







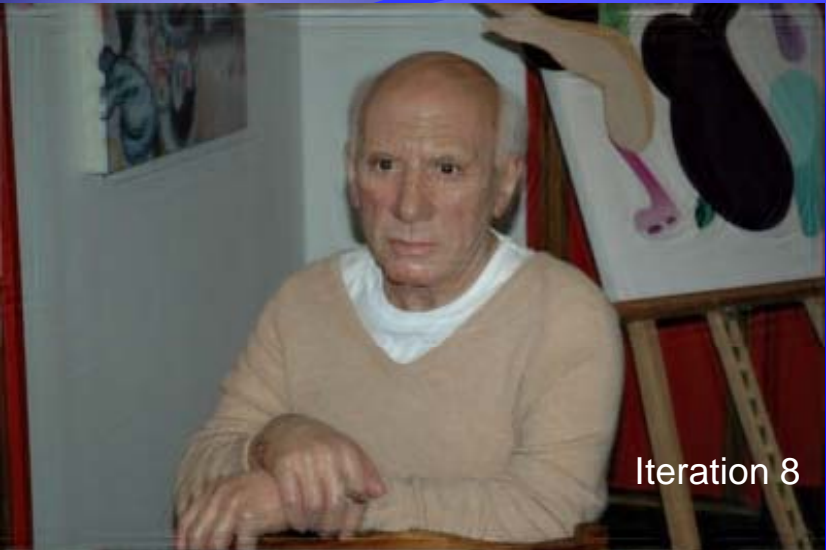
Iteration 4

 =  \otimes  + 








Iteration 6

 =  \otimes  + 




Iteration 8


 =  \otimes  + 




Convergence








Results










Results




 =  ⊗  + 


Results




 =  ⊗  + 


Results










More results










More results




 =  ⊗  + 





More results



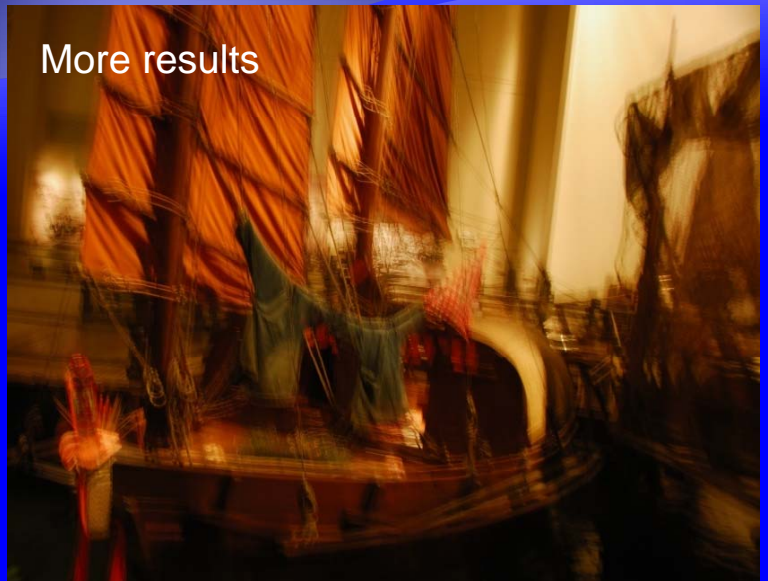
 =  ⊗  + 





More results




 =  \otimes  + 

More results



 =  \otimes  + 

More results



Blurred Image



Ours (kernel size 95x95)



同圖像銳化比較

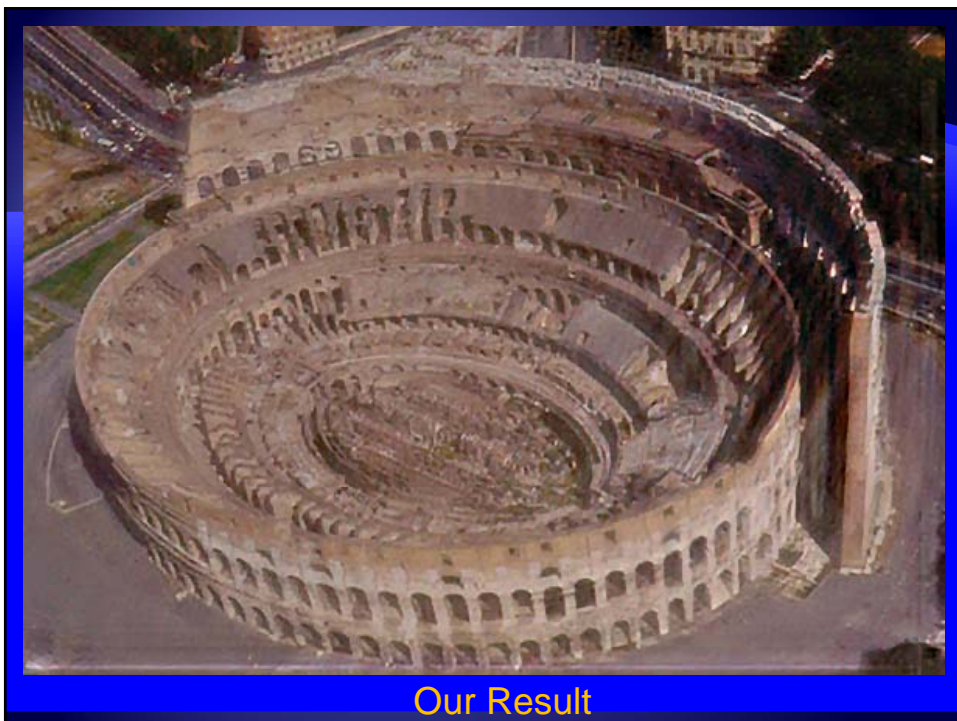


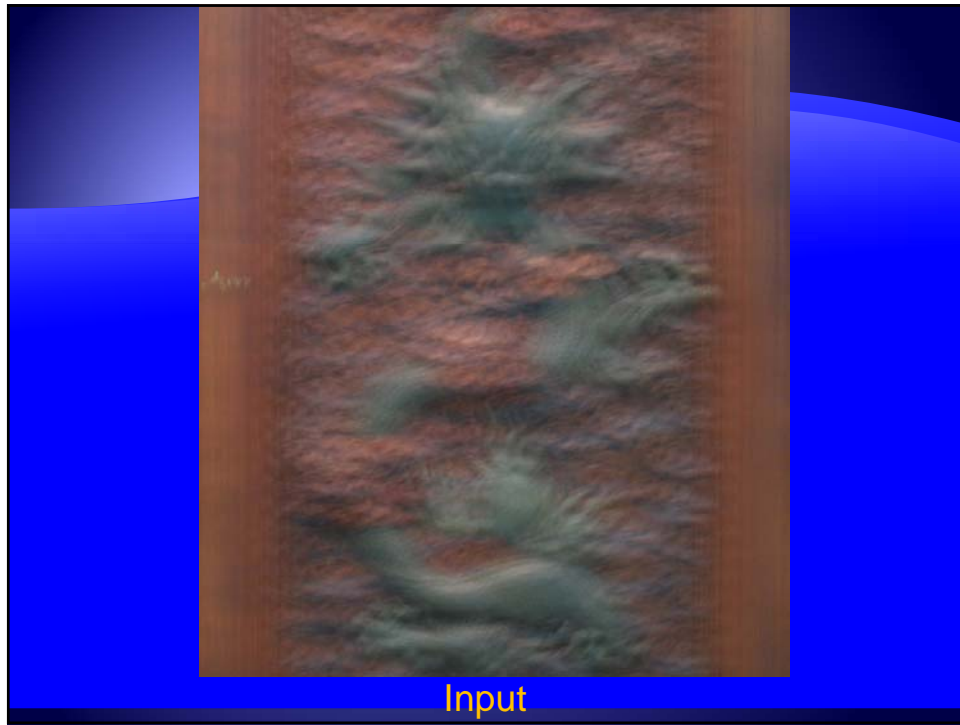
Input

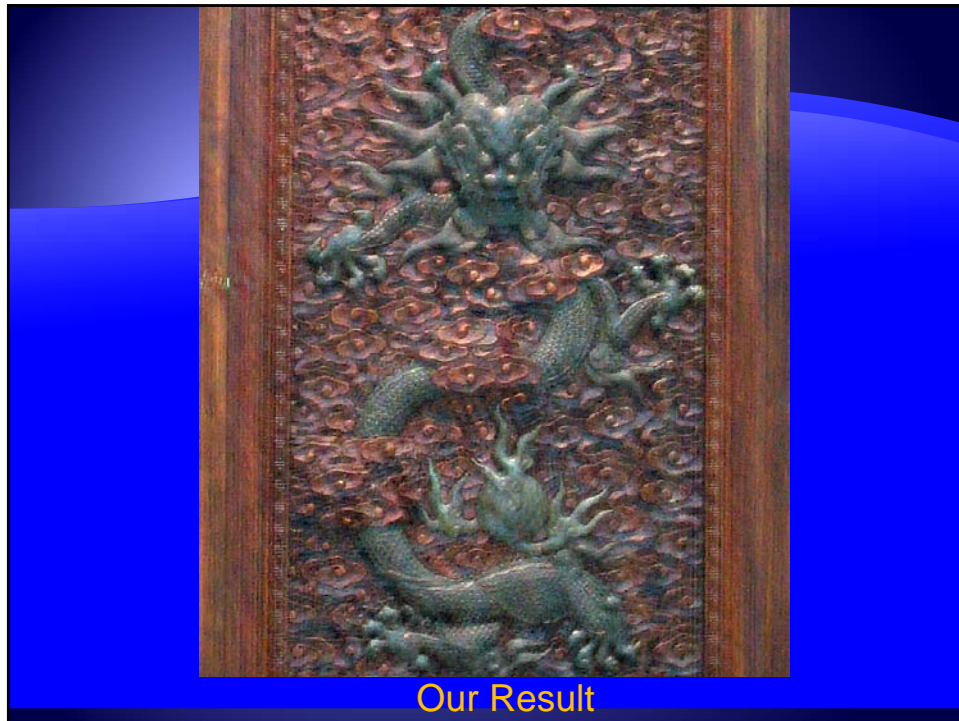






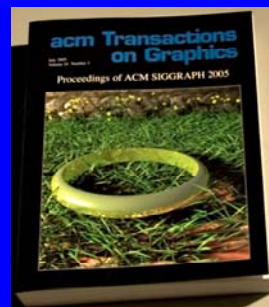






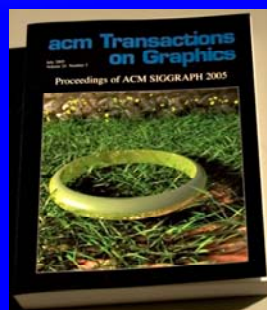
Running Time (運行時間)

- ◆ Blind deconvolution
 - Approximately 10 minutes for an 800 x 600 image



Running Time (運行時間)

- ◆ Blind deconvolution
 - ~~Approximately 10 minutes for an 800 x 600 image~~
Less than 5 seconds in our new software



Applications (應用)

- ◆ Shooting in Wide (野外拍攝)



<http://www.flickr.com/photos/gnas/4489347457/sizes/z/in/photostream/>

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Applications (應用)

- ◆ Shooting in Wide (野外拍攝)



http://www.flickr.com/photos/sarah_mccans/289935079/

Applications (應用)

- ◆ Shooting in Wide (野外拍攝)



Applications (應用)

- ◆ Shoot in Night (夜間拍攝)



Applications (應用)

- ◆ Shoot in Night (夜間拍攝)



Applications (應用)

- ◆ Medical images (醫學圖像)



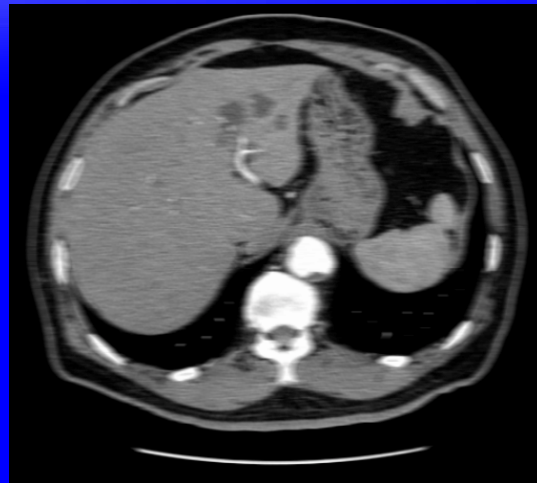
Applications (應用)

- Medical images (醫學圖像)



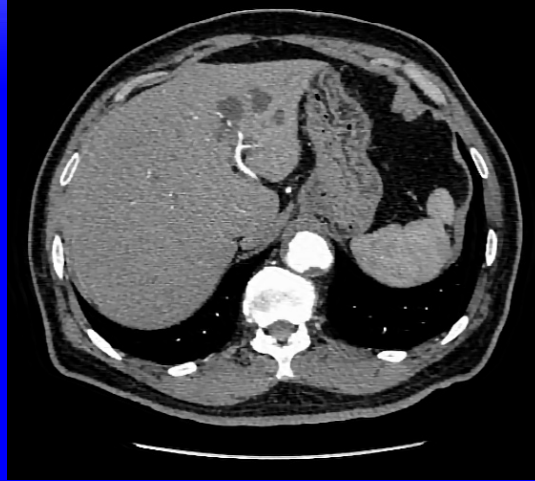
Applications (應用)

- Medical images (醫學圖像)



Applications (應用)

- ◆ Medical images (醫學圖像)



Applications (應用)

- ◆ Face



<http://www.flickr.com/photos/8279528@N03/519193225/>

Applications (應用)

- ◆ Face



Applications (應用)

- ◆ Plate (車牌)



Applications (應用)

- ◆ Plate (車牌)



Applications (應用)

- ◆ Plate (車牌)



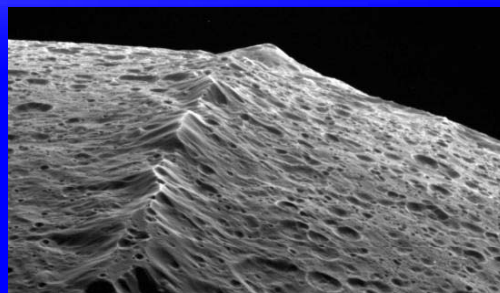
Applications (應用)

- ◆ Plate (車牌)



Applications (應用)

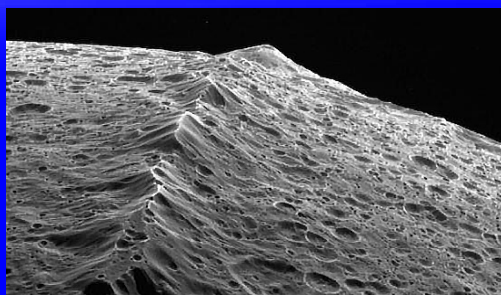
- ◆ Astronomy (天文)



This image was taken during Cassini's close approach to the moon Iapetus in Sept. 2007. (NASA/JPL/SSI)

Applications (應用)

- ◆ Astronomy (天文)



Applications (應用)

- ◆ Satellite images (衛星圖像)



Applications (應用)

- ◆ Satellite images (衛星圖像)



Applications (應用)

- ◆ Legacy images (舊照修復)



Development Details (研究情況)

- ◆ From 1.2010 – 7.2011 (1.5 years)
- ◆ People involved:
 - ◆ Dr. XU, Li (researcher 研究員) and me for algorithm development
 - ◆ 2 master students for coding (編寫程式)
- ◆ Grant spent:
 - ◆ HK\$ 60,000 for computer equipment
 - ◆ HK\$ 150,000 for US patent application

Thank you

