A Modified Method of Extracting Filaments from Astronomical Images

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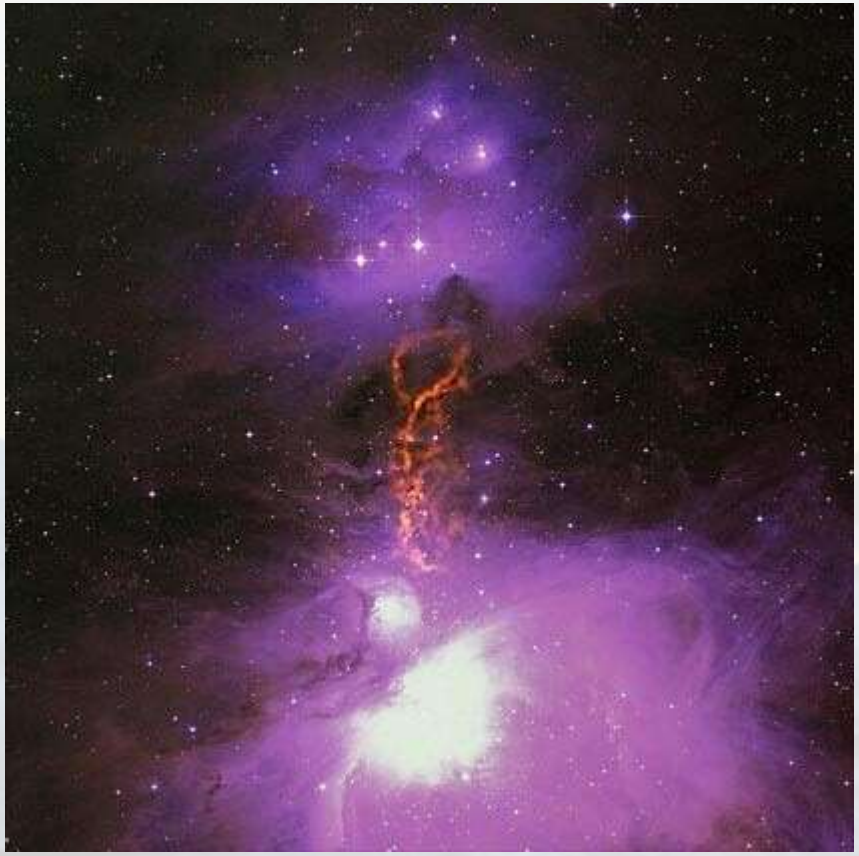
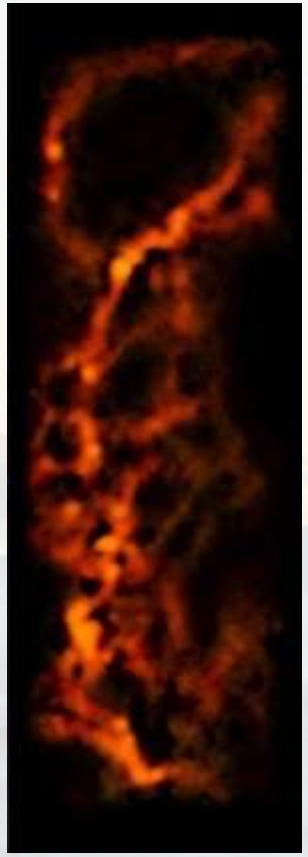
Introduction

Filaments are a type of wide-existing astronomical structure.

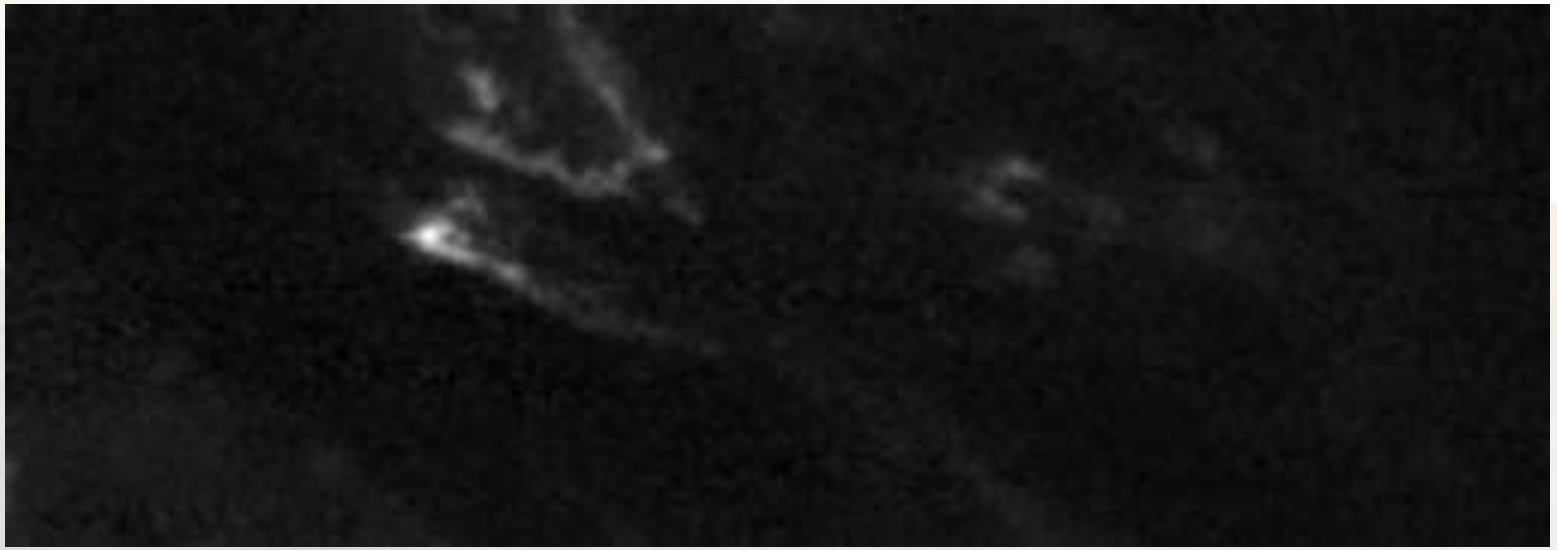




How to extract filaments from these images?

Challenges

1. Filamentary radiation intensity is usually weak.
2. Filaments often mix with bright objects, e.g. stars.
3. The structures of filaments doesn't have a well description in math,It has both the feature of the large and small scale structure.
4. It is difficultt to separate them from background images.



Arecibo 21cm HI fits image,Galactic coordinate system l=99.3~114.8,b= -58~-54.3,LSR speed is -60km/s

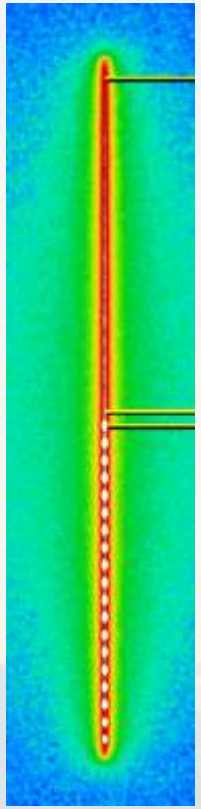
Relative Work

In 2013, **A. Men'shchikov** proposed a multi-scale, multi-wavelength filament extraction method which was used to extract filaments from bright sources, noise, and isotropic background.

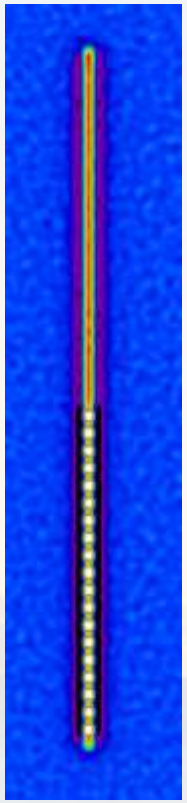
Ref:

A. Men’shchikov, A multi-scale filament extraction method: getfilaments, 2013

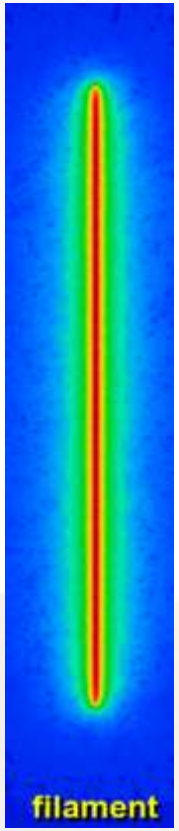
Relative Work



Simulated filaments
(include dot source and noise)



One of the flatten images



Experiment result

Ref:
A. Men'shchikov, A multi-scale filament extraction method: getfilaments, 2013

Local Info. vs Global Info.

A. Men'shchikov's Method

For each flatten image

- Use local information to remove tiny structures: counting connected pixels number.
- May remove some part of the filaments because filaments in real astronomic image are usually weak.

Our Method

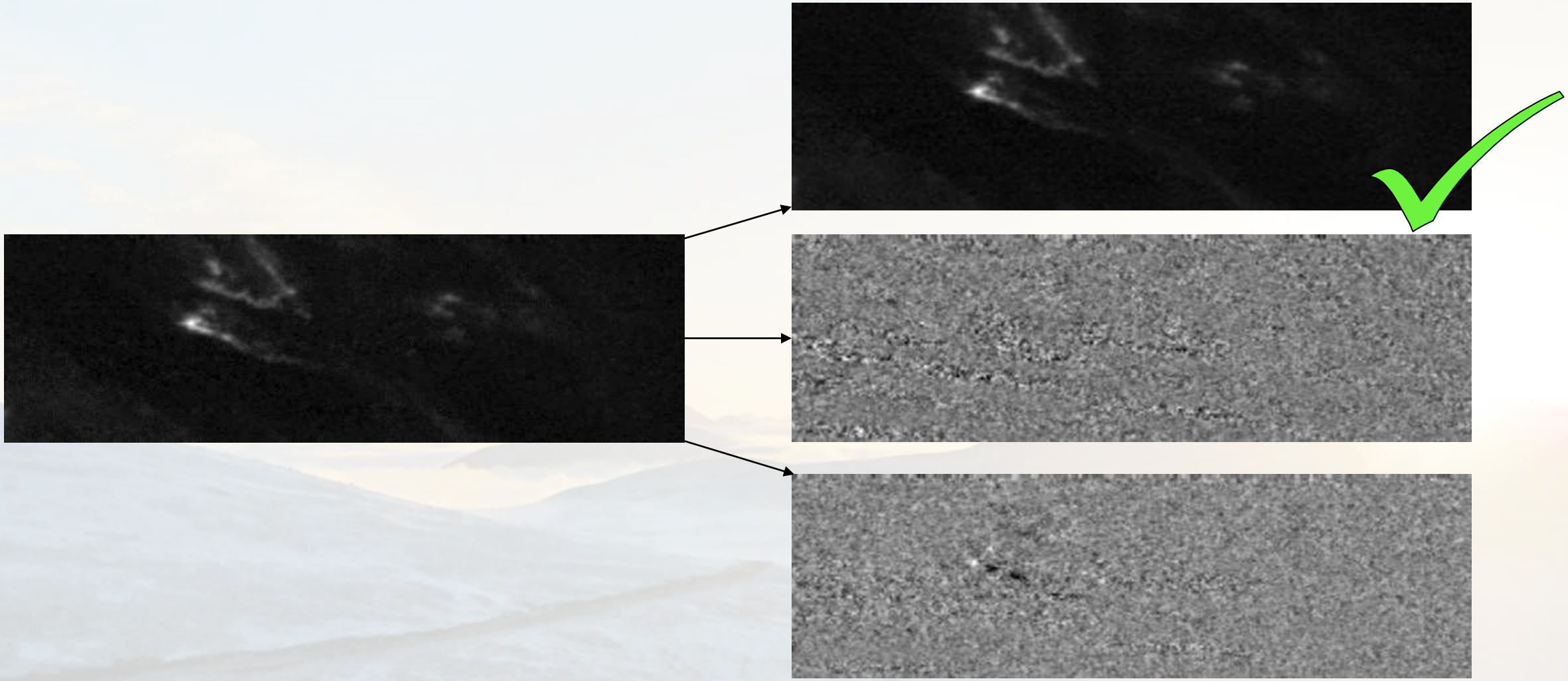
For each flatten image

- Use global information to remove noise and tiny objects: MCA (Morphology Components Analysis)
- Remove line structure, gauss structure but keep the structure of filaments.

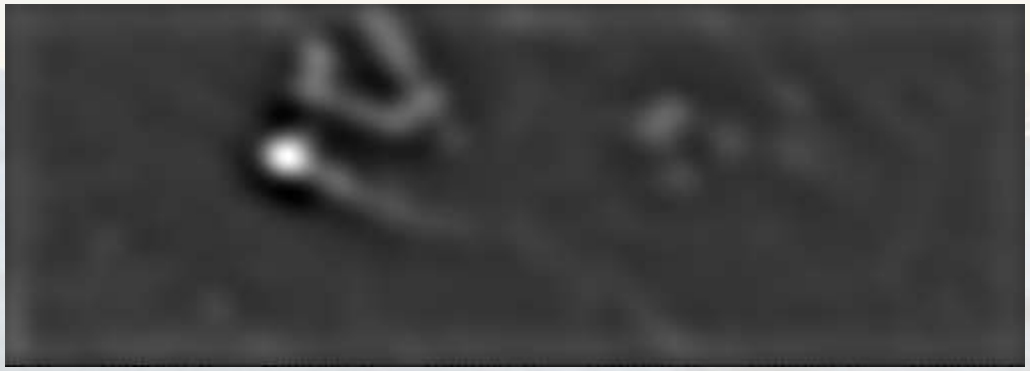
Process of our method

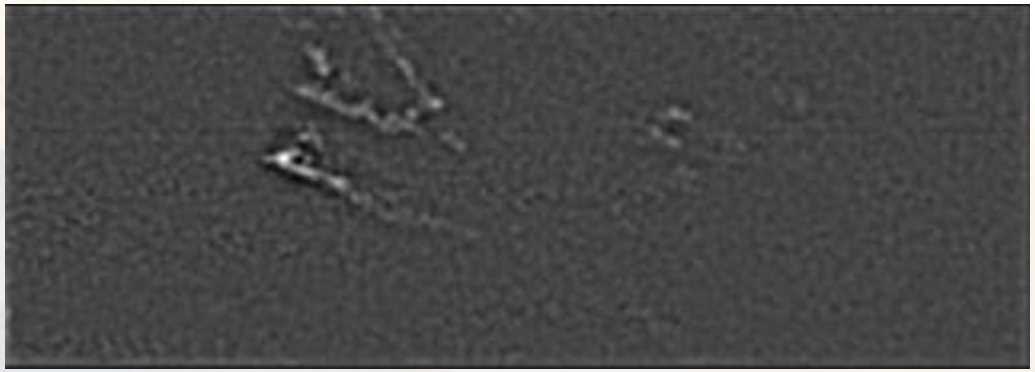
- Pre-process: Blind Source Separation
- Get flatten images (multi-scale images) N layers
- Use Morphological Component Analysis (MCA) to remove background and tiny structures
- Combine flatten images

Pre-processing (Blind Source Separation, BSS)



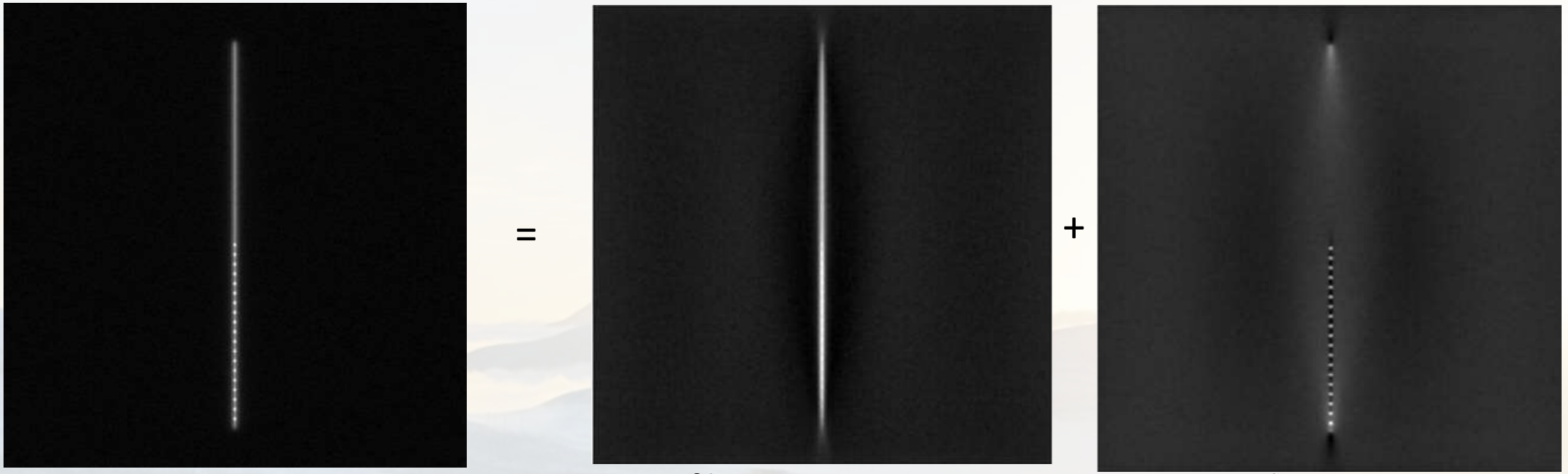
Get flatten images





Four images of the 70 flatten images

MCA on simulated image

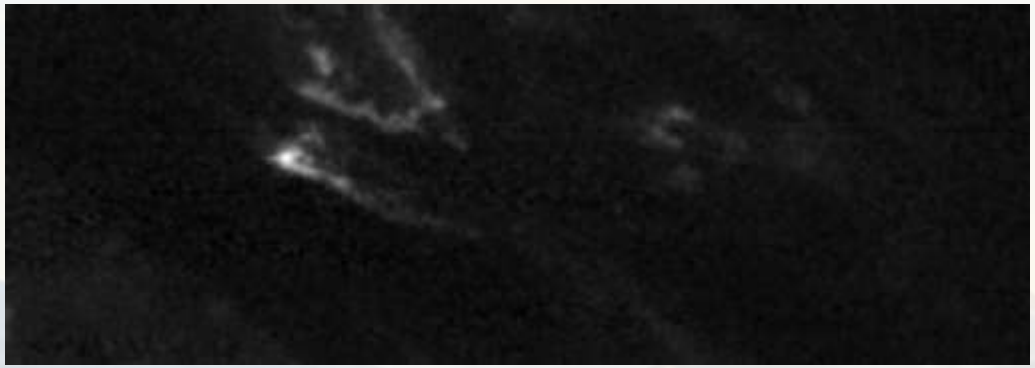


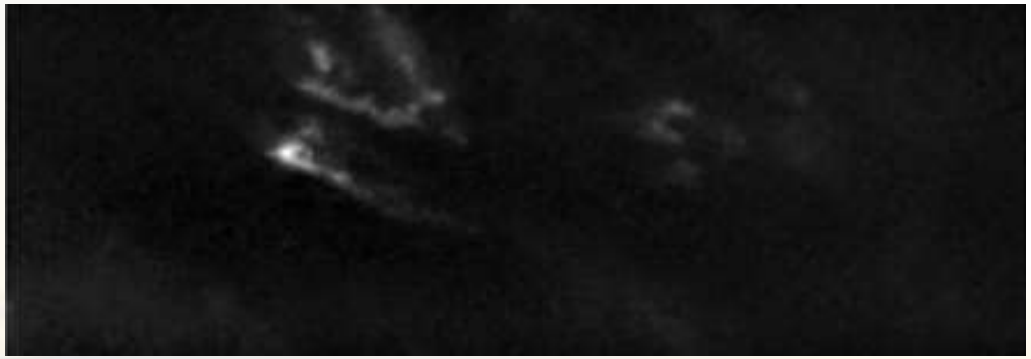
simulated image | filaments | dot source

Ref:

A. Men'shchikov, A multi-scale filament extraction method: getfilaments, 2013

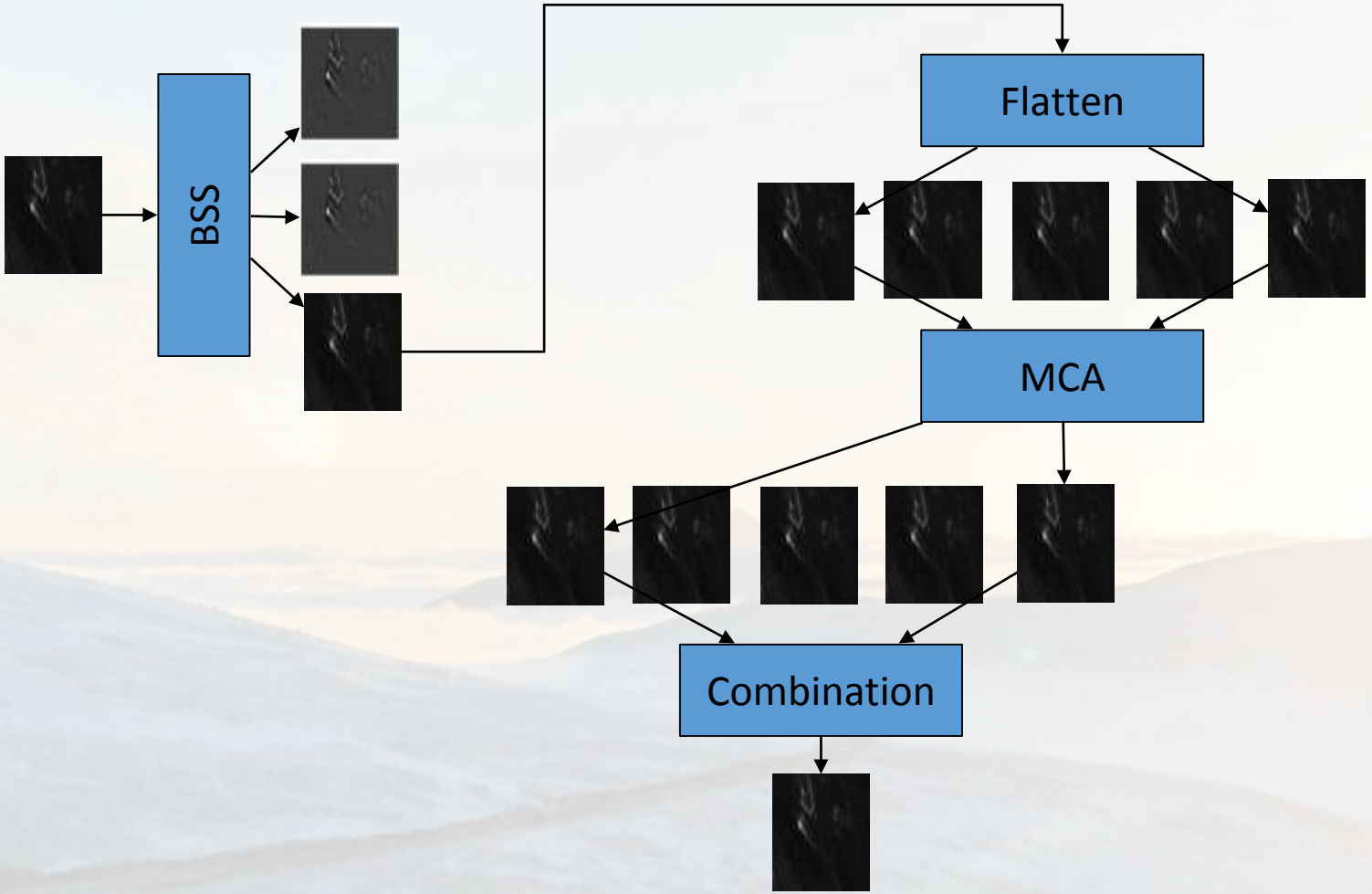
MCA on astronomical image



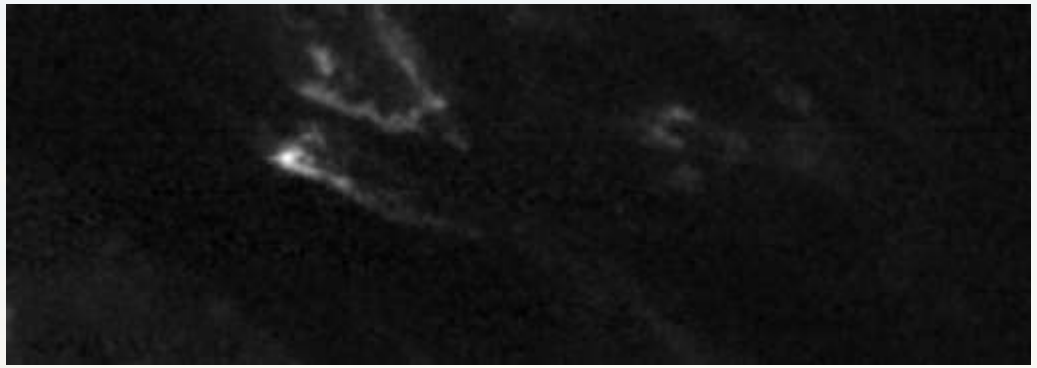


Arecibo 21cm HI fits image,Galactic coordinate system l=99.3~114.8,b= -58~-54.3,LSR speed is -60km/s

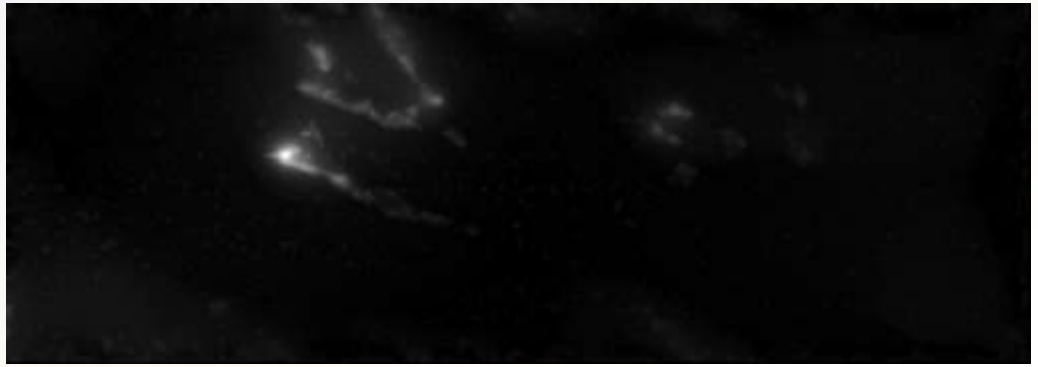
Process of our method



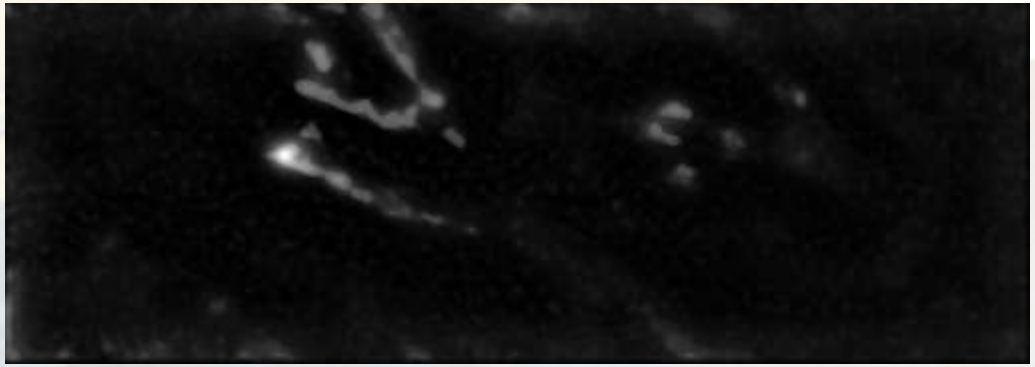
Processing Result



Original Image



Processing Result



Processing Result with parameters adjustment

Conclusion

1. The decompositon method proposed by A. Men'shchikov is reasonable for astronomical image processing.

2. We used global information in flatten image to remove background and tiny structure in our method and got a good experiment result.

3. Algorithm used in our method like BSS and MCA have many parameters to adjust and need a further research.

Acknowledgements

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Thanks for your attention!