



**HAL**  
open science

# Unifying the refocusing algorithms and parameterizations for traditional and focused plenoptic cameras

Charlotte Herzog, Ombeline de La Rochefoucauld, Fabrice Harms, Philippe Zeitoun, Xavier Granier

► **To cite this version:**

Charlotte Herzog, Ombeline de La Rochefoucauld, Fabrice Harms, Philippe Zeitoun, Xavier Granier. Unifying the refocusing algorithms and parameterizations for traditional and focused plenoptic cameras. ICCP 2019 - IEEE International Conference on Computational Photography 2019, May 2019, Tokyo, Japan. Institute of Electrical and Electronics Engineers, 2019. hal-02096378

**HAL Id: hal-02096378**

**<https://inria.hal.science/hal-02096378v1>**

Submitted on 15 May 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# Unifying the refocusing algorithms and parameterizations for traditional and focused plenoptic cameras

Charlotte Herzog<sup>1,2,3</sup>, Xavier Granier<sup>2,3,4</sup>, Fabrice Harms<sup>1</sup>, Philippe Zeitoun<sup>5</sup> & Ombeline de La Rochefoucauld<sup>1</sup>

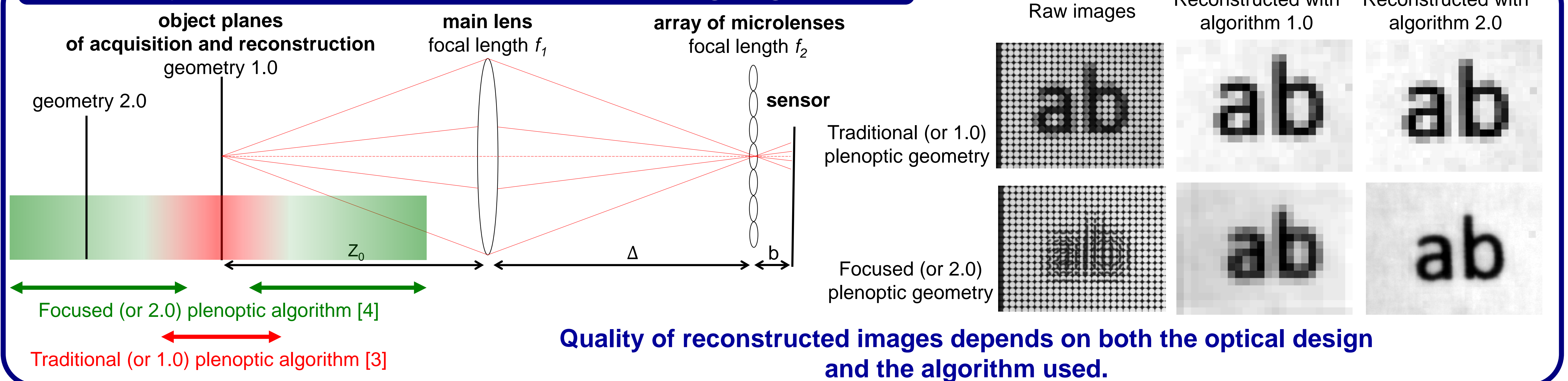
<sup>1</sup>Imagine Optic, Orsay/Bordeaux, France; <sup>2</sup>Laboratoire Photonique, Numérique et Nanosciences, Talence, France

<sup>3</sup>Inria Bordeaux Sud-Ouest; <sup>4</sup>UMS Archeovision 3D SHS, Pessac, France; <sup>5</sup>Laboratoire d'Optique Appliquée, UMR7639, Palaiseau, France

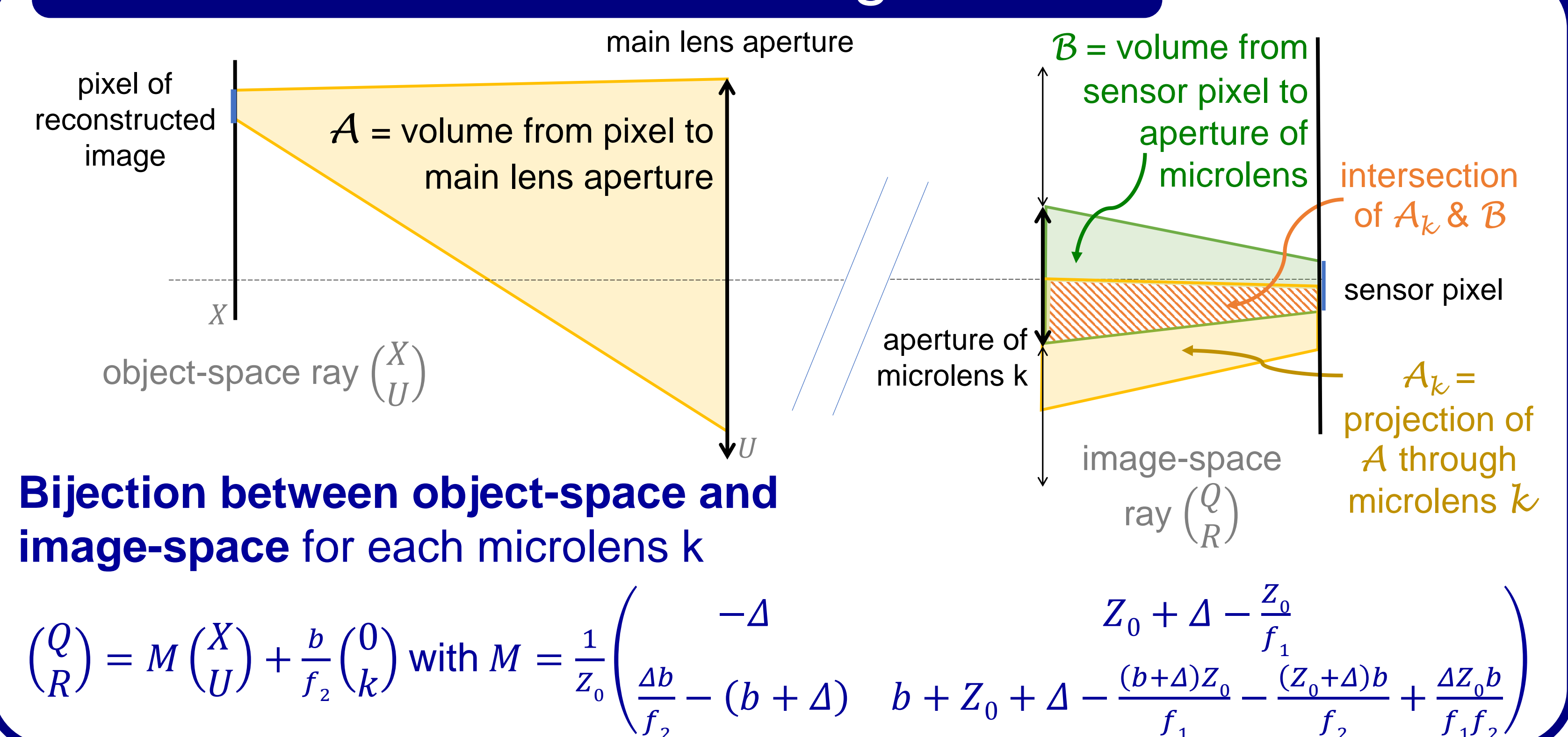
## Introduction

A plenoptic camera allows to acquire and separate spatial and directional information of the light coming from a scene [1, 2]. It allows applications such as refocusing at different depths from the one where the image has been acquired. In the literature, different refocusing algorithms are presented for several optical plenoptic configurations [3 - 6]. We have previously shown the continuity between these optical designs, and the similarities and differences between the associated algorithms [7]. Here we propose a unique parameterization of the light rays in a plenoptic setup, allowing the development of a unique refocusing algorithm valid for any plenoptic configurations, based on the integration of étendues' intersections in the image-space. With this method, we aim at refocusing images at any distances from the camera, without the discontinuity due to the change of optical configurations.

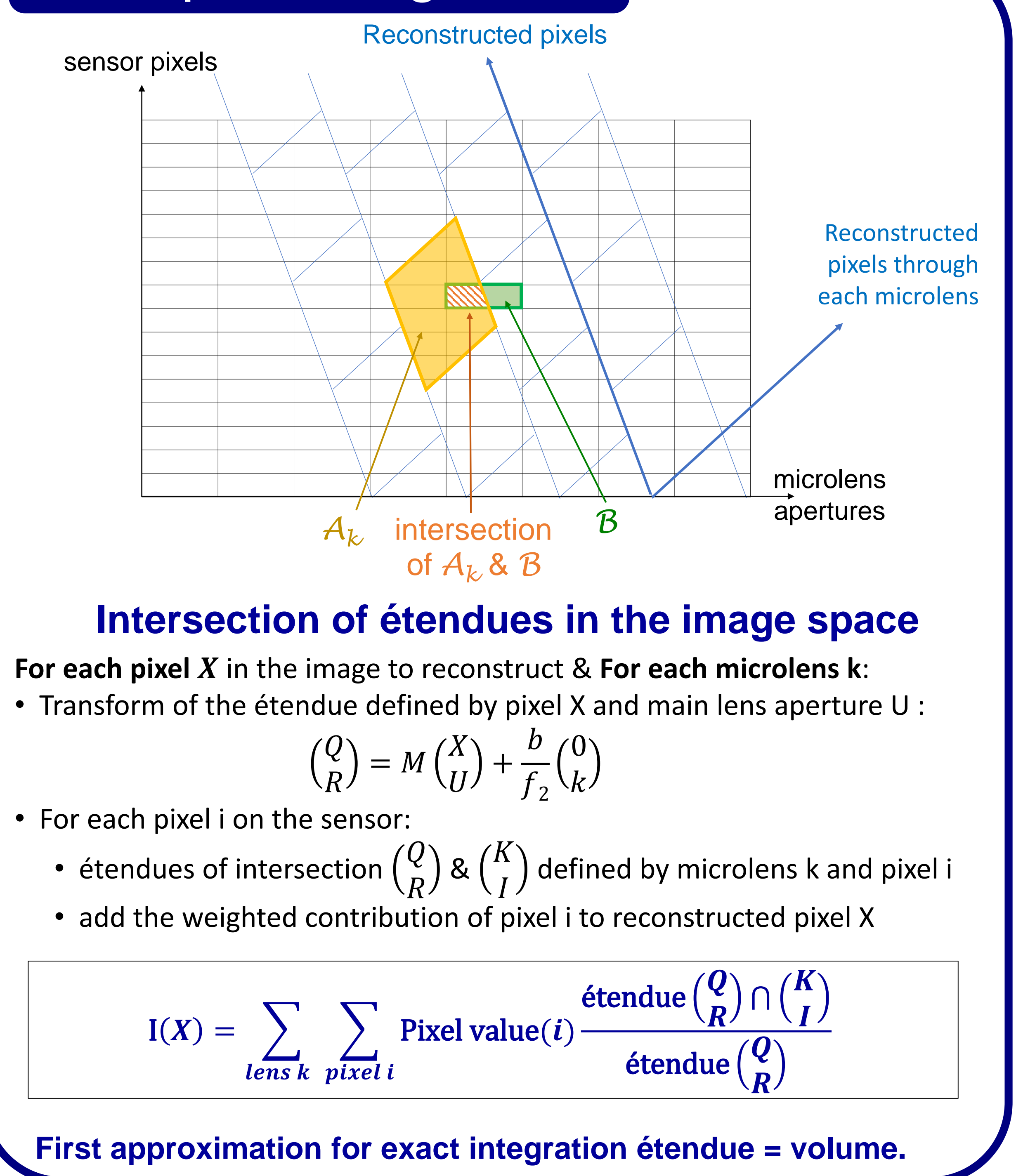
## 1. Validity domains of historical refocusing algorithms



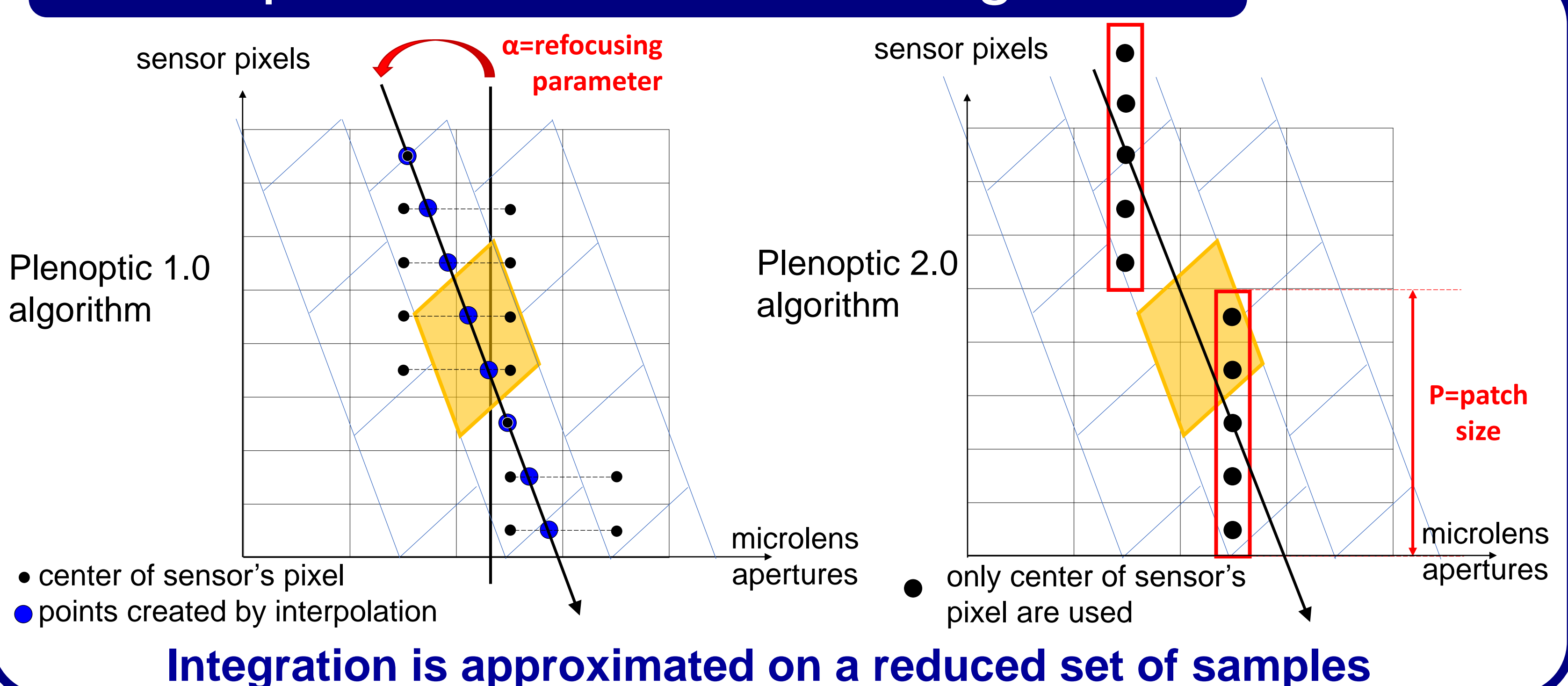
## 2. Parametrization of the Light-Field



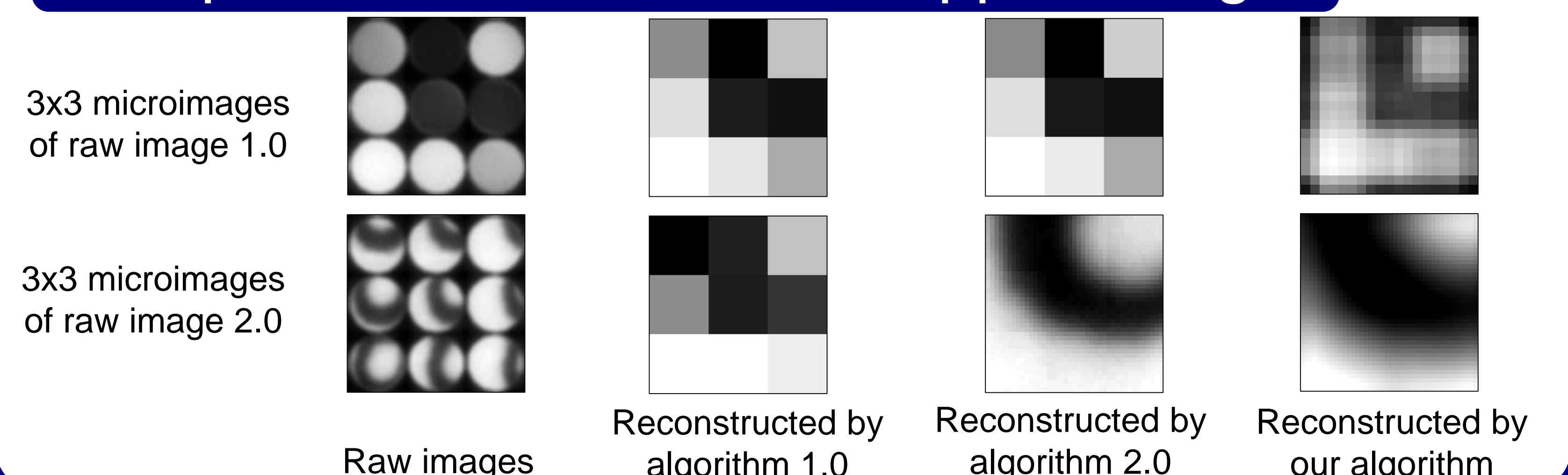
## 3. Proposed algorithm



## 4. Comparison with historical algorithms



## 5. Experimental results on cropped images



## Conclusions

- Unification of the two historical algorithms.
- Algorithm based on the intersection of étendues instead of using pixels as points.
- First implementation of algorithm → validation of the idea.
- Future work: improving execution time.

## References

[1] E. Y. Lam, J. Opt. Soc. Am. A, vol. 32, no. 11, pp. 2021–2032, Nov. 2015.  
 [2] M. Martínez-Corral and B. Javidi, Adv. Opt. Photonics, vol. 10, no. 3, p. 512, 2018.  
 [3] R. Ng, thesis, Stanford University, 2006.  
 [4] T. Georgiev and A. Lumsdaine, J. Electron. Imaging, vol. 19, no. 2, p. 021106, 2010.  
 [5] J. Fiss, B. Curless, and R. Szeliski, in 2014 IEEE International Conference on Computational Photography (ICCP), 2014, p. 5.  
 [6] M. Hog, N. Sabater, B. Vandame, and V. Drazic, IEEE Trans. Comput. Imaging, vol. 3, no. 4, pp. 811–821, Dec. 2017.  
 [7] C. Herzog et al., in Proc. SPIE 10677, Unconventional Optical Imaging, 2018, vol. 106772U, p. 104.