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# A Quasi-panoramic Bio-inspired Eye for Flying Parallel to Walls

Erik Vanhouette, Franck Ruffier, Julien Serres

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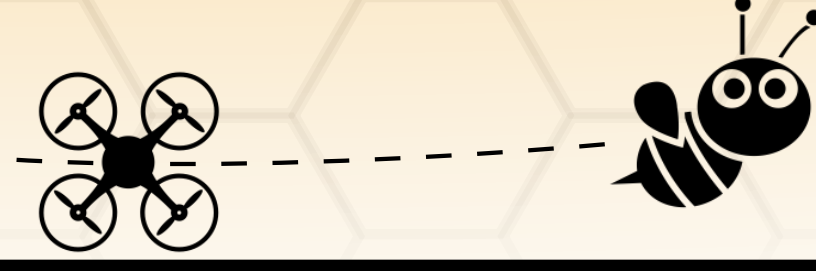
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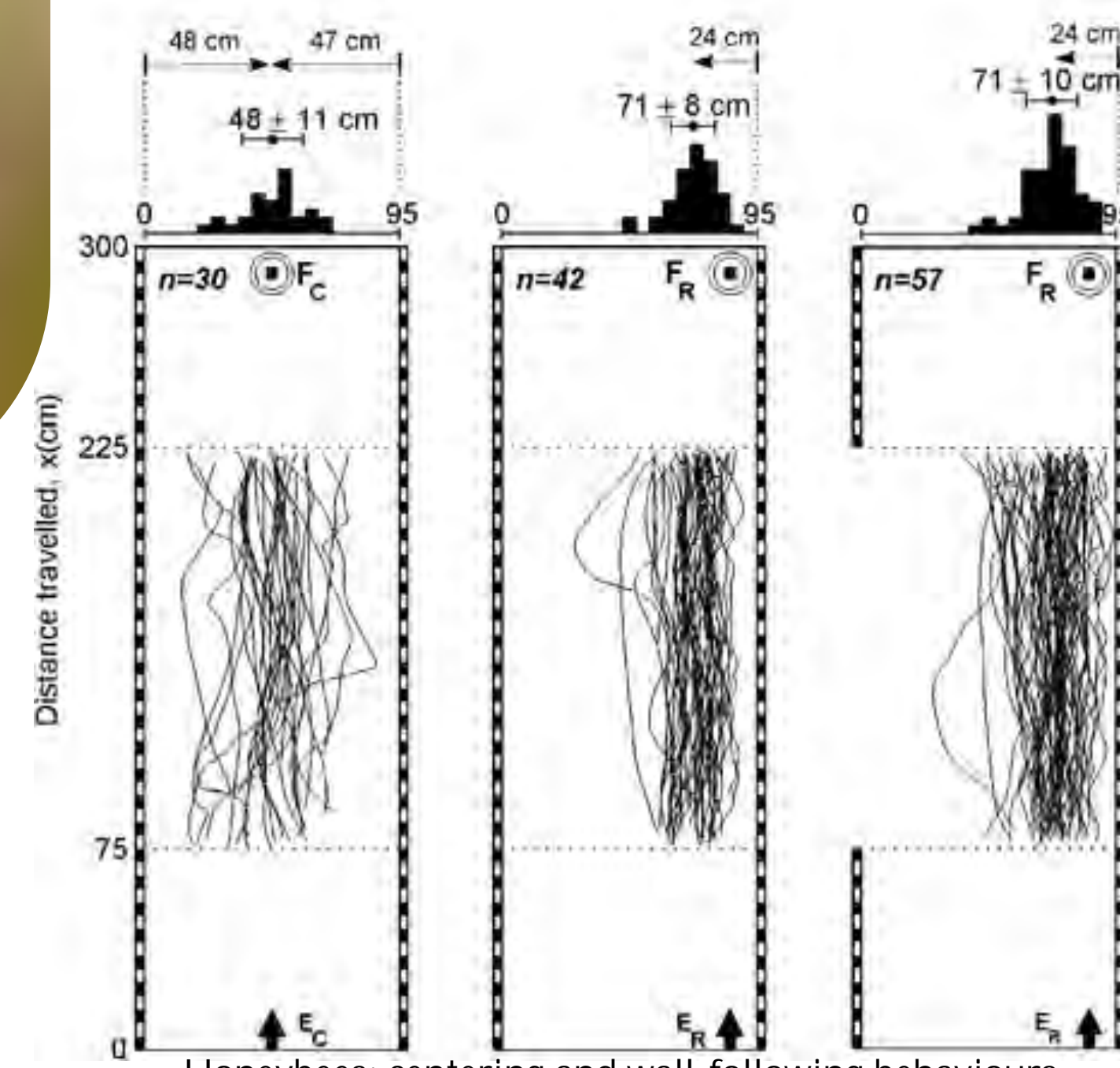
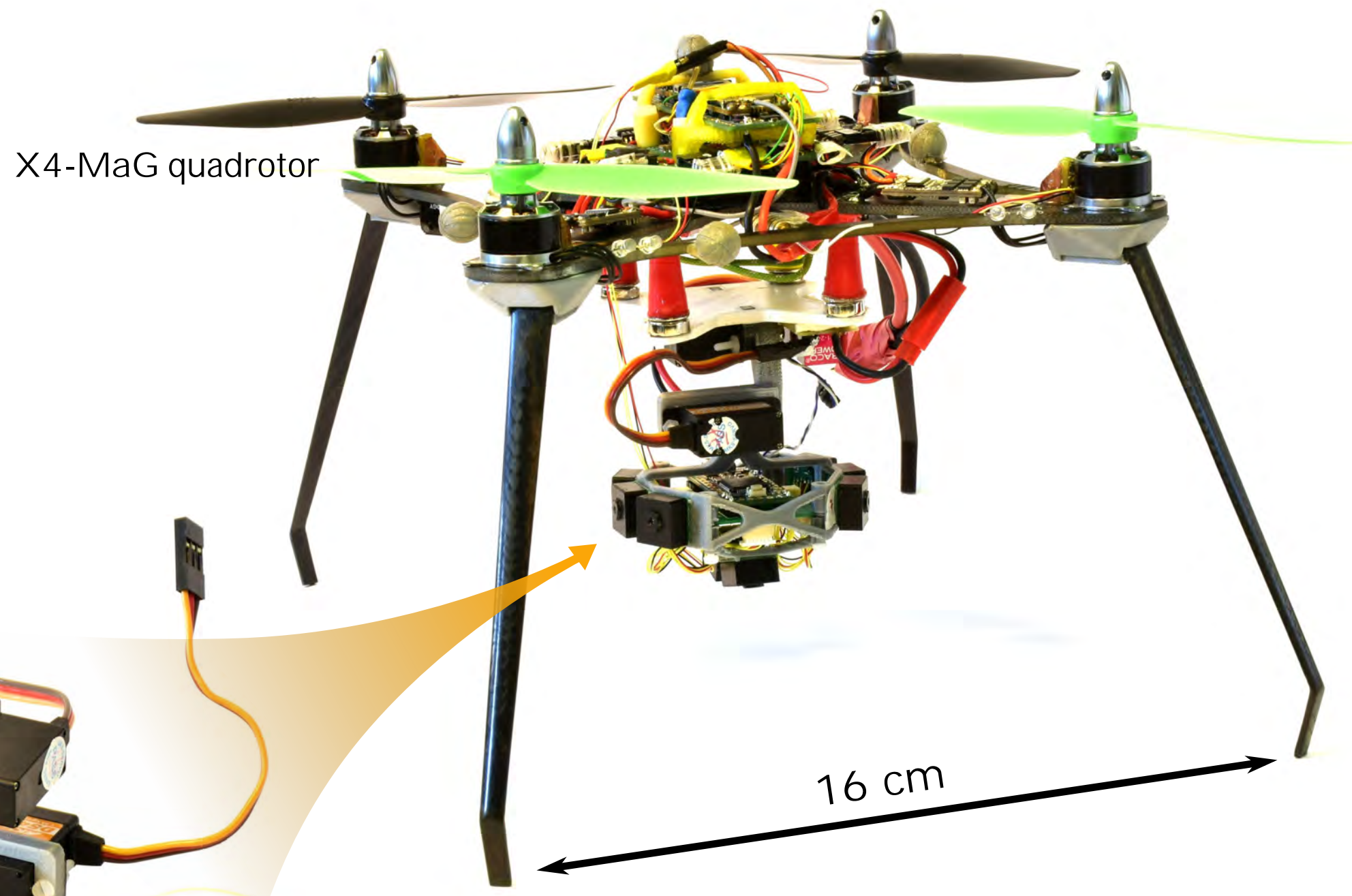
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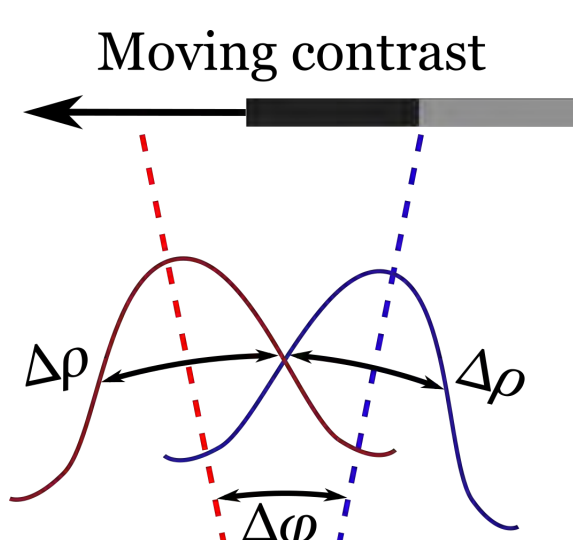
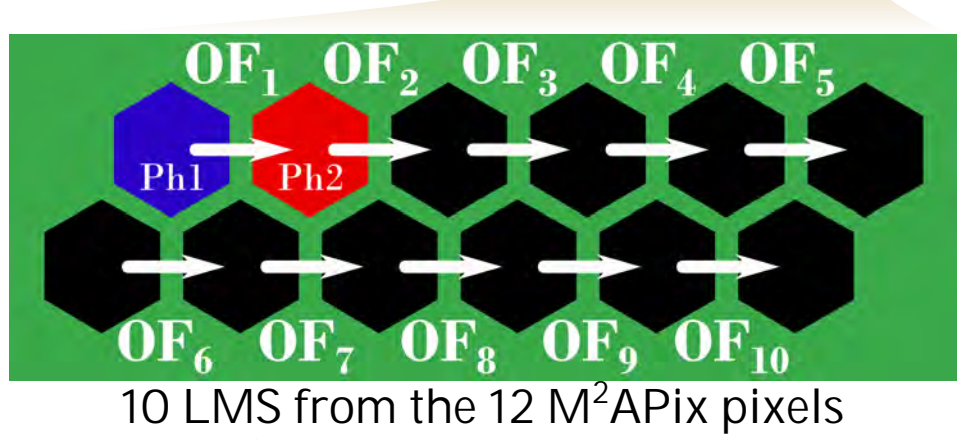
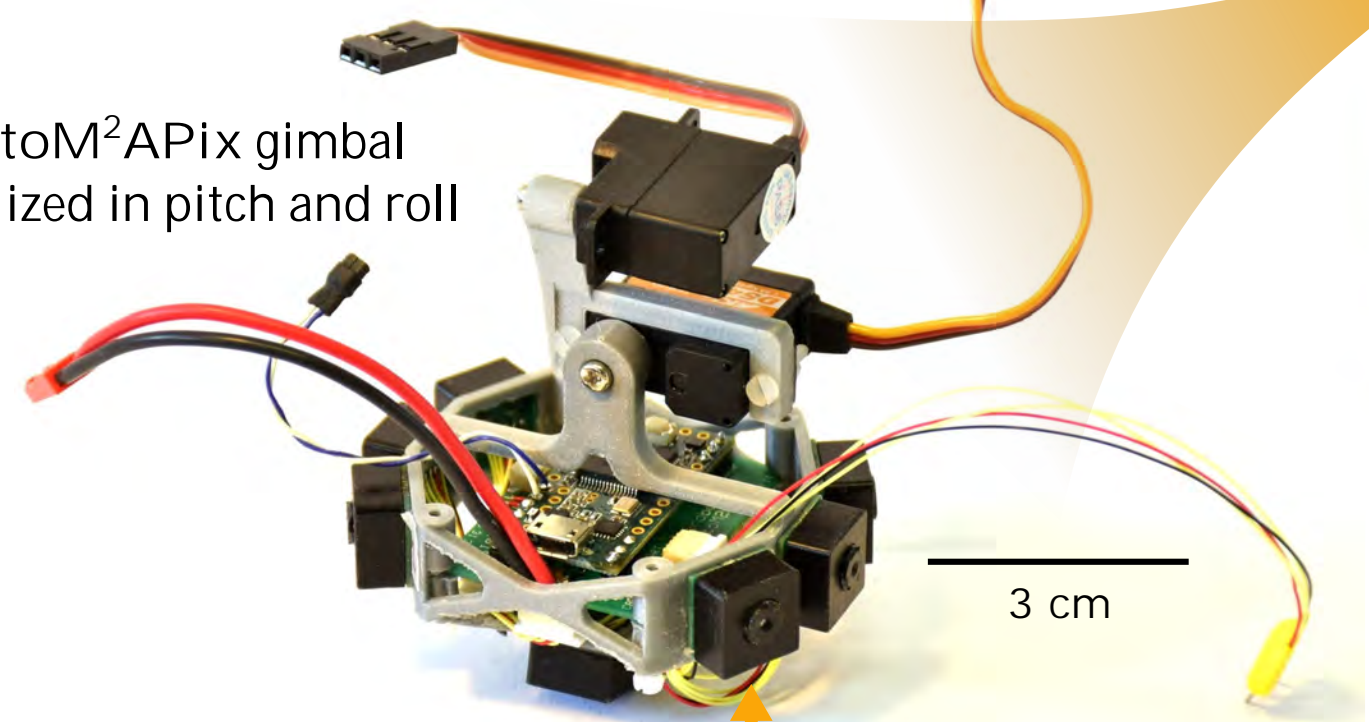
# A Quasi-panoramic Bio-inspired Eye for Flying Parallel to Walls



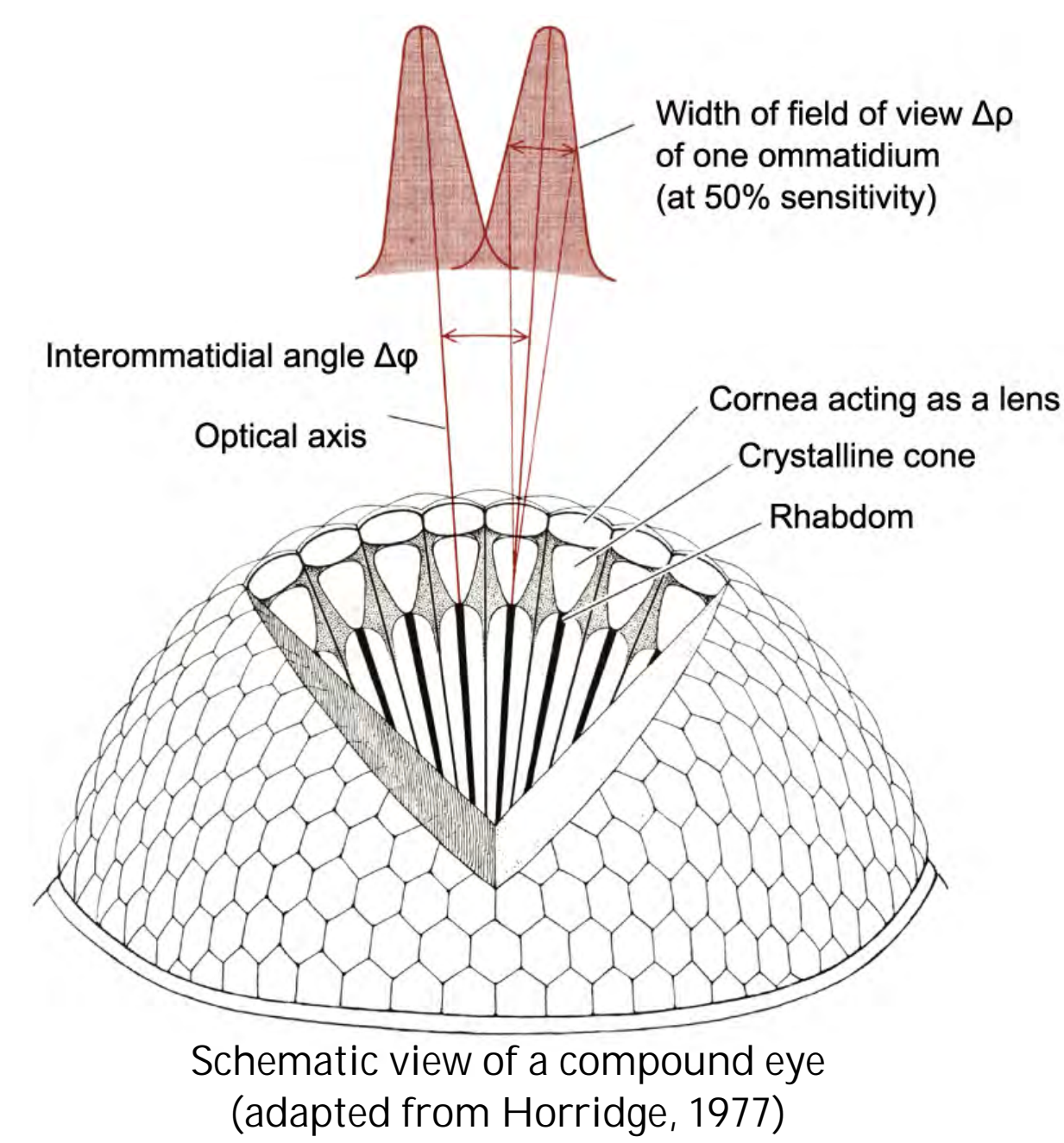
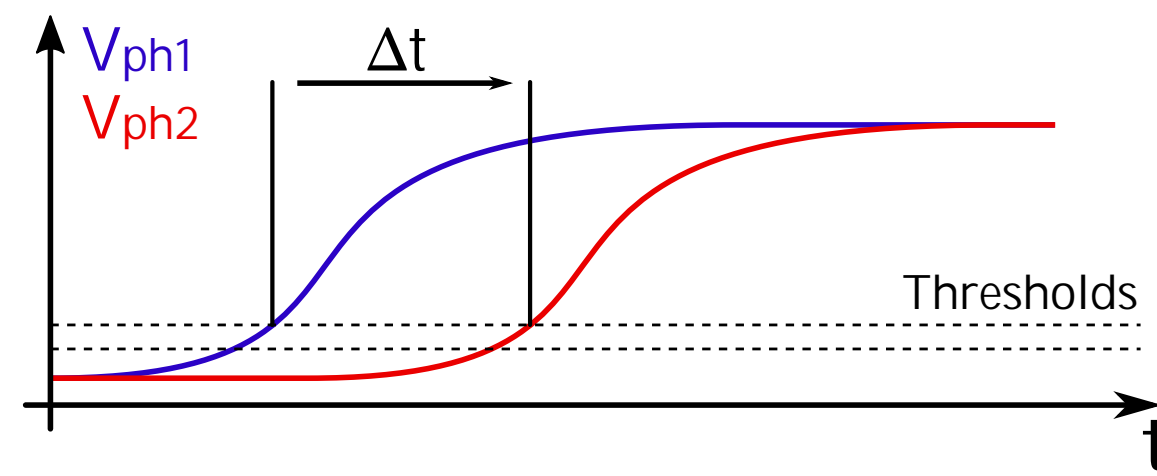
Erik Vanhoutte, Franck Ruffier, and Julien Serres  
Aix-Marseille University, ISM, Marseille, France



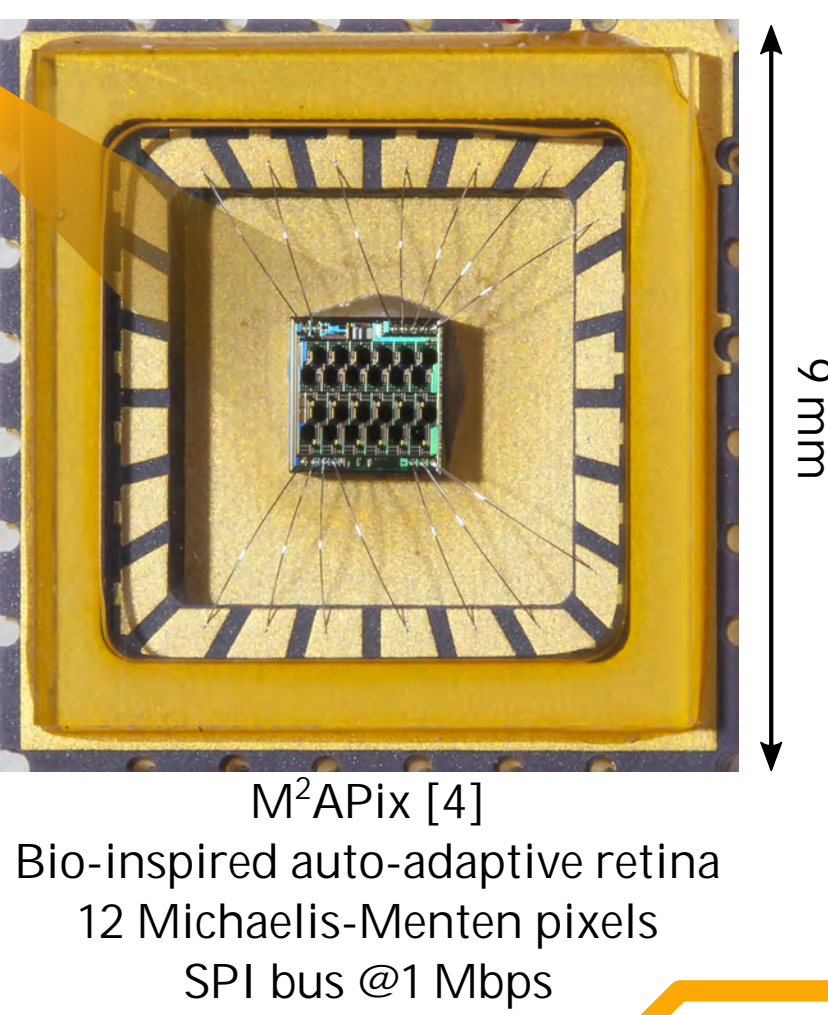
## Biorobotics



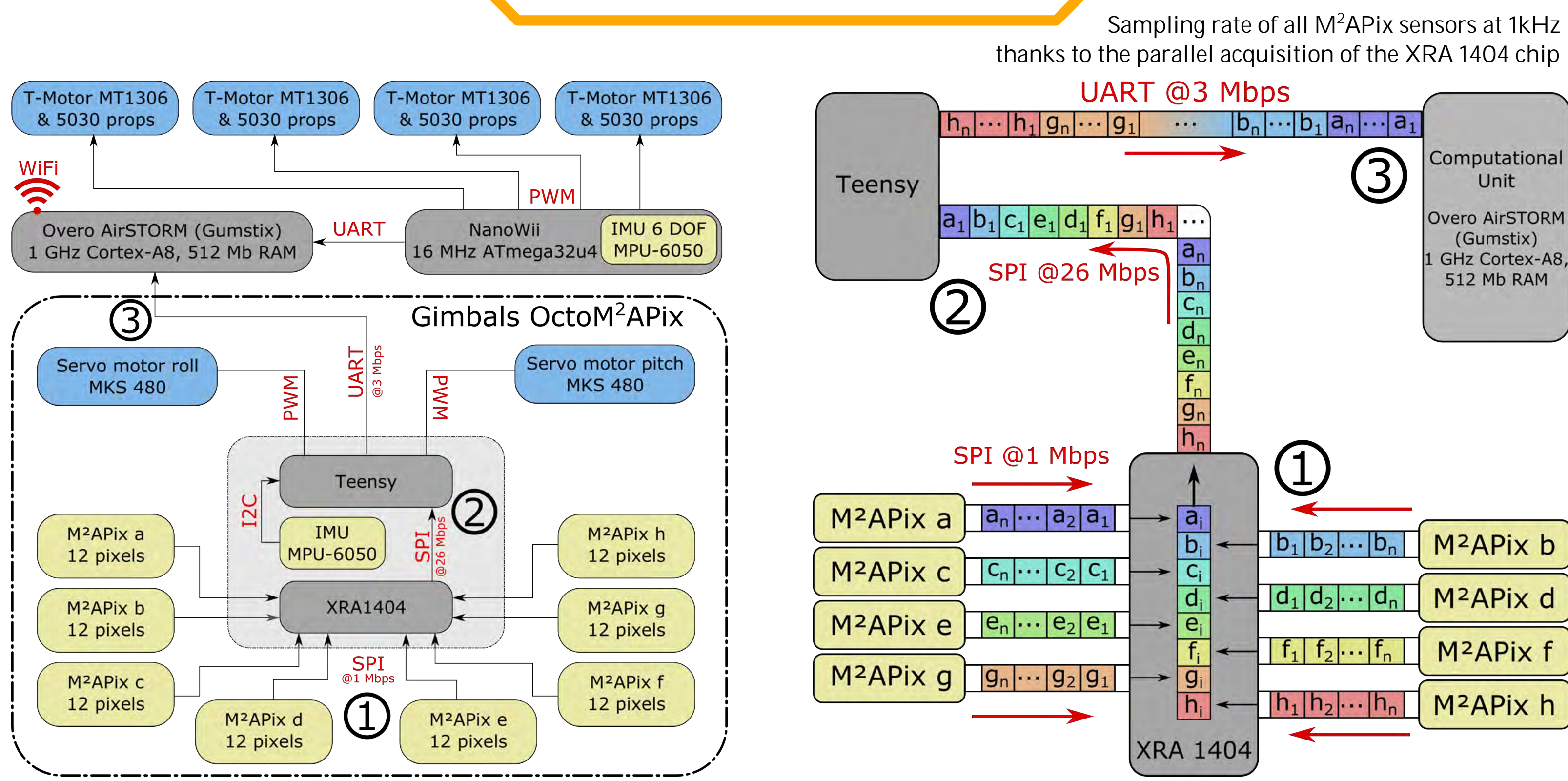
Time-of-travel computation based on signals thresholding [2]



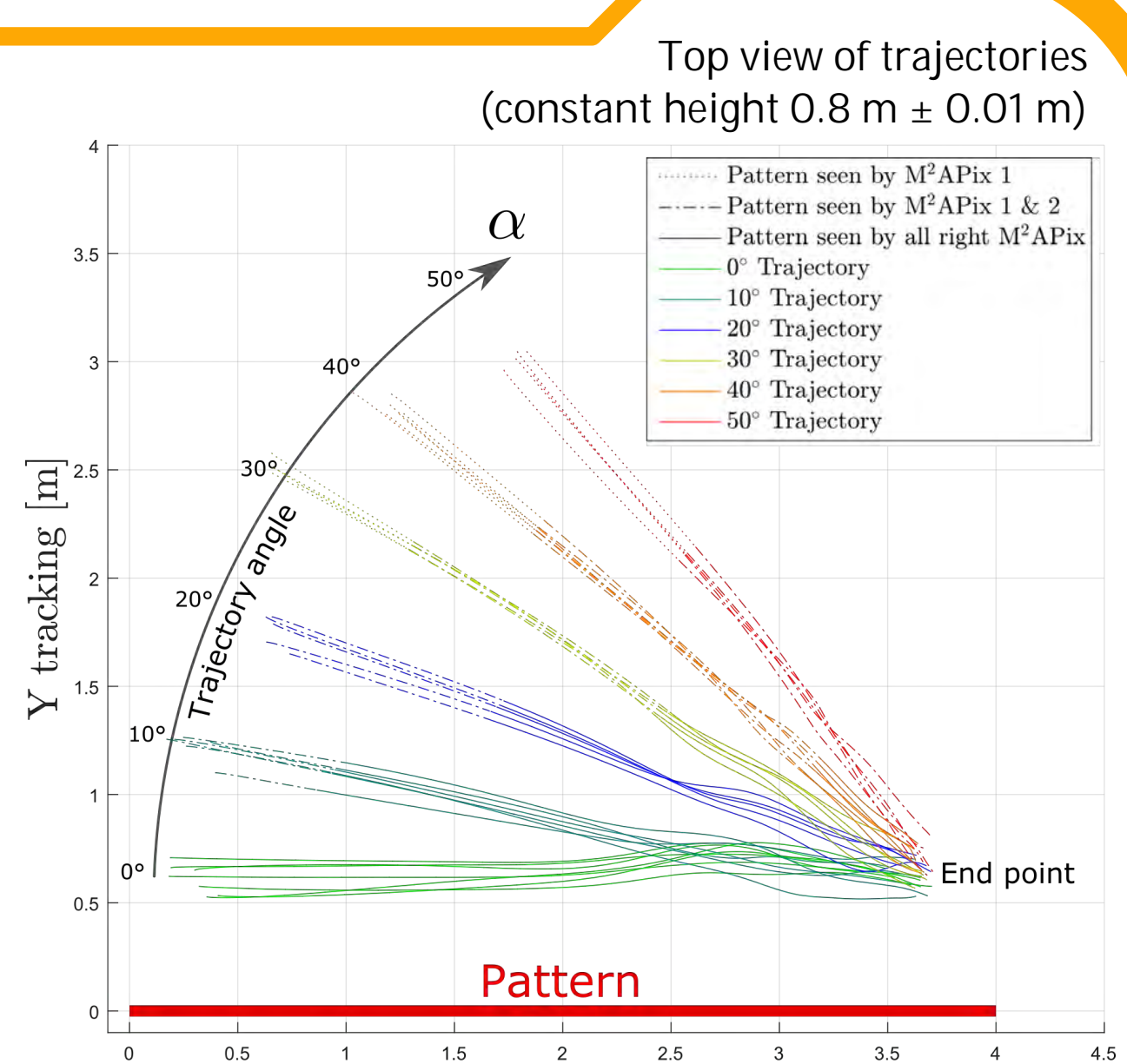
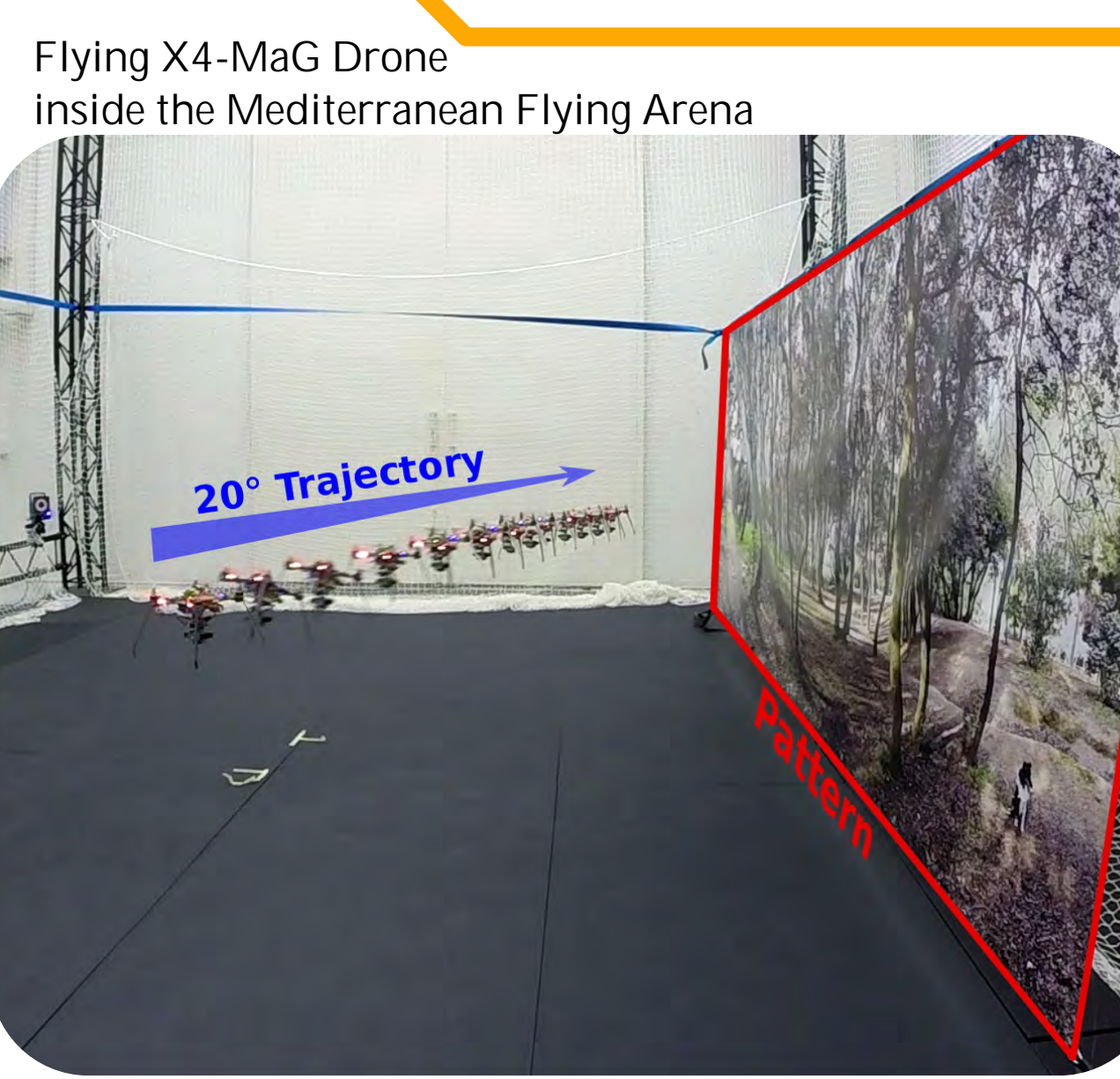
Megachile fortis (by USGS Bee Inventory and Monitoring Lab)



### OctoM²APix Electronics & Data



### Angle of Incidence computing in flight [5]

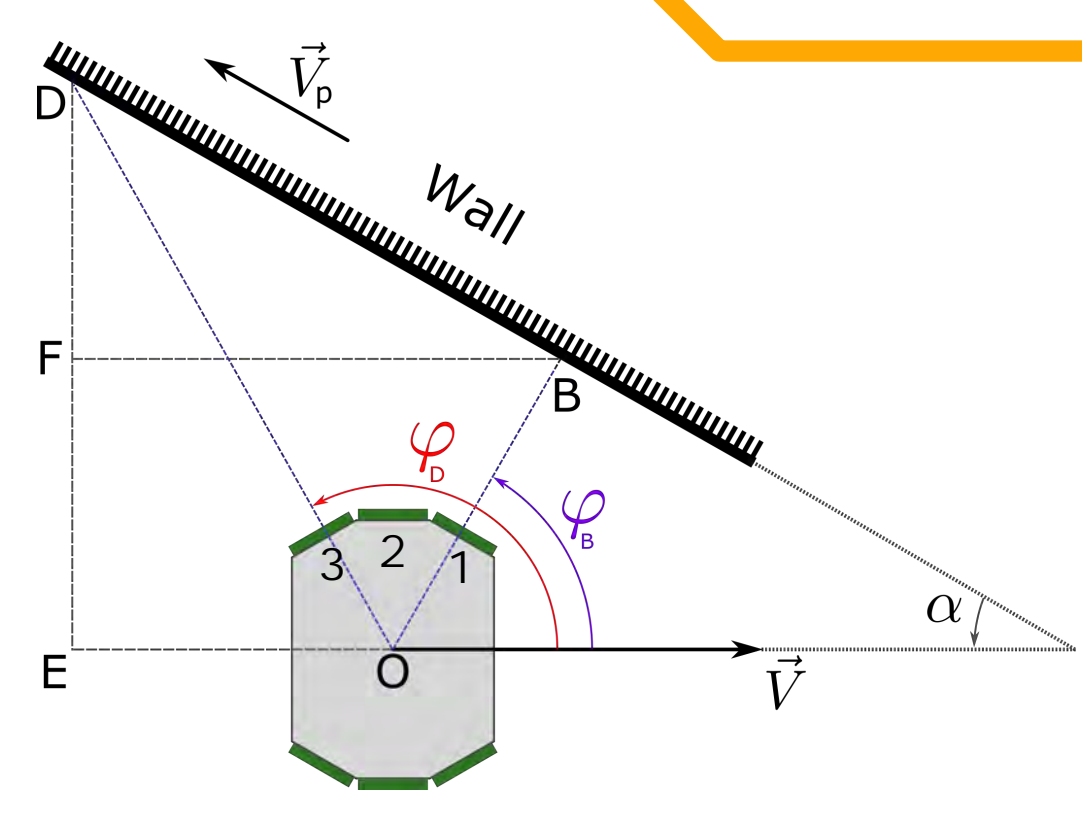


Angle of incidence error (Median ± IQR)

α	OF > 50°/s			OF < 50°/s		
	1&2	2&3	1&3	1&2	2&3	1&3
0°	2° ± 11°	-1° ± 10°	0° ± 7°	9° ± 25°	-4° ± 12°	3° ± 13°
10°	1° ± 10°	-9° ± 10°	-6° ± 7°	12° ± 22°	-1° ± 12°	6° ± 12°
20°	2° ± 10°	-22° ± 8°	-13° ± 4°	10° ± 17°	-8° ± 12°	1° ± 10°
30°	-2° ± 6°	-	-	7° ± 13°	-9° ± 23°	-4° ± 9°
40°	-3 ± 4°	-	-	-3° ± 11°	-8° ± 18°	-6° ± 14°
50°	-	-	-	-3° ± 16°	-	-

With the optic configuration of M²APix sensors (Δφ=3.4° & Δρ=3.8°) OF measurements are reliable above 50°/s

### Angle of Incidence principle & first results



Angle of Incidence computing from two optic flow measurements

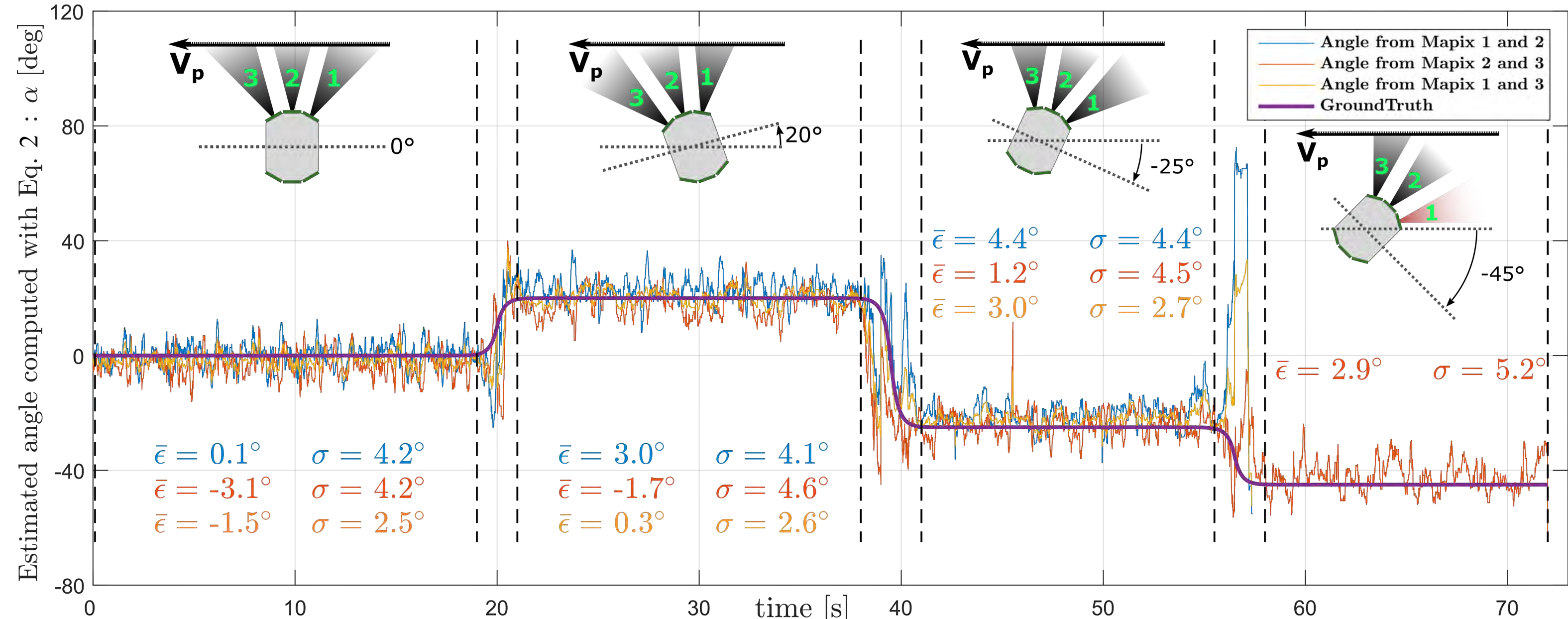
$$\omega_B = \frac{V}{OB} \cdot s(\varphi_B) \quad \omega_D = \frac{V}{OD} \cdot s(\varphi_D)$$

$$t(\alpha) = \frac{OD \cdot s(\varphi_D) - OB \cdot s(\varphi_B)}{OB \cdot c(\varphi_D) - OD \cdot c(\varphi_B)}$$

$$t(\alpha) = \frac{\omega_B \cdot s(\varphi_D)^2 - \omega_D \cdot s(\varphi_B)^2}{\omega_D \cdot s(\varphi_B) \cdot c(\varphi_B) - \omega_B \cdot s(\varphi_D) \cdot c(\varphi_D)} \quad (1)$$

$$\text{if } V \neq 0 \quad t(\alpha) = \frac{\omega_B \cdot s(\varphi_D + \alpha) \cdot s(\varphi_B) - \omega_D \cdot s(\varphi_B + \alpha) \cdot s(\varphi_D)}{\omega_D \cdot s(\varphi_B + \alpha) \cdot c(\varphi_B) - \omega_B \cdot s(\varphi_D + \alpha) \cdot c(\varphi_D)} \quad (2)$$

First results with a moving texture



### Reference and contact

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Erik Vanhoutte  
PhD student  
Biorobotics Dpt.

