

# Subjective Quality Evaluation of H.264 High-Definition Video Coding versus Spatial Up-Scaling and Interlacing

QoEMCS Workshop – EuroITV'2010 06.09.2010

Yohann Pitrey

Marcus Barkowsky

Patrick Le Callet

Romuald Pepion

IRCCyN lab, IVC group  
NANTES, FRANCE  
Ecole Polytechnique de  
l'Universite de Nantes



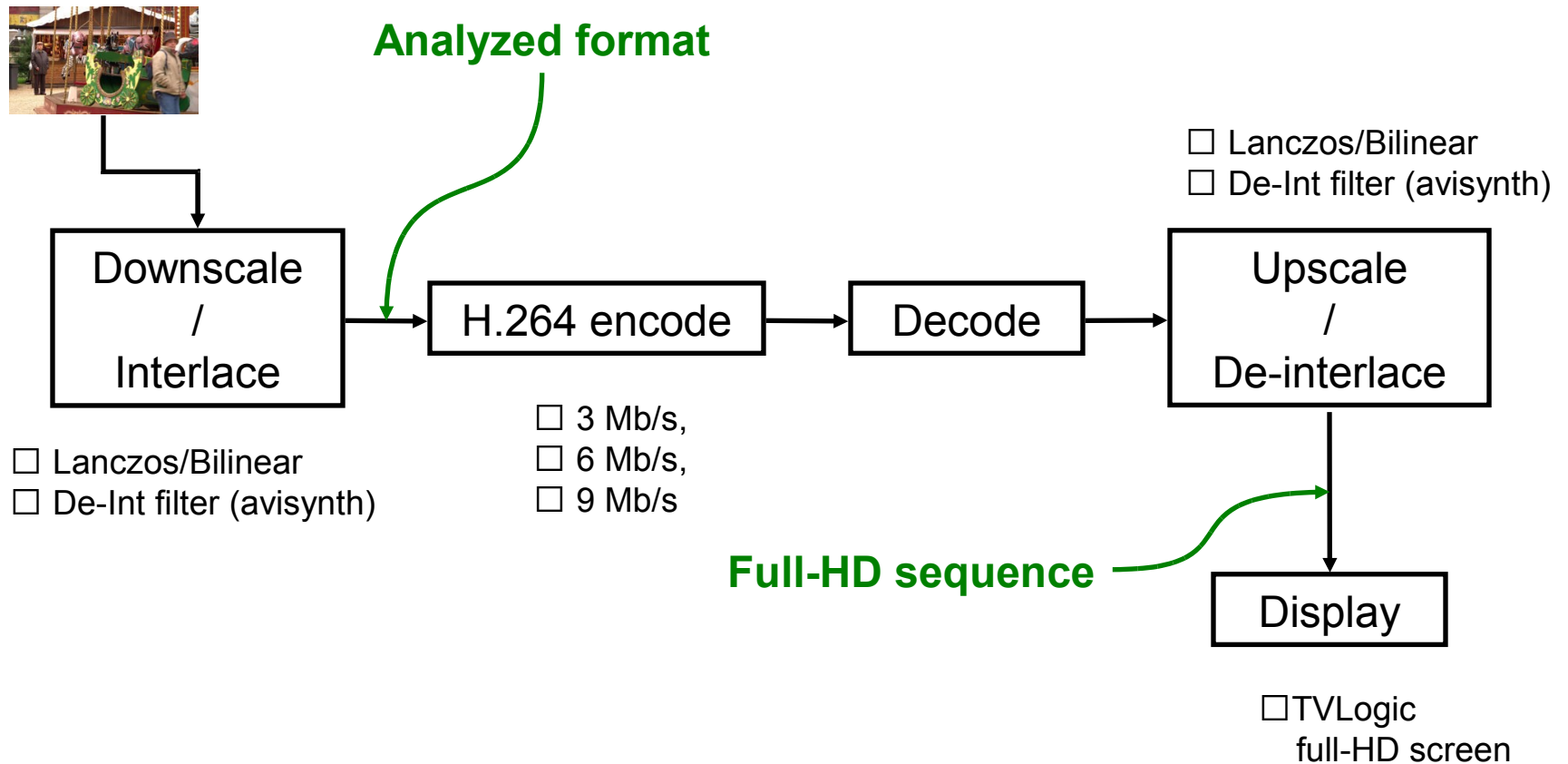
# Outline

---

- Setup
  - Process flow
  - Video formats
  - Pre/post processing tools
  - Test environment
  - Quality assessment methodology
- Experimental results
  - Graphical Opinion Score analysis
  - Statistical analysis
- Conclusions

# Process flow

## Full-HD sequence



# Video formats

## 1080p

(1920x1080, 1 244 Mb/s)



## 720p

(1280x720, 552 Mb/s)



## SD

(720x576, 248 Mb/s)



## 1080i

(1920x540, 622 Mb/s)



## 1080i2/3

(1280x540, 415 Mb/s)



## 1080p2/3

(1280x1080, 829 Mb/s)



# Video formats

## Spatial Upscaling

**1080p**

(1920x1080, 1 244 Mb/s)



**720p**

(1280x720, 552 Mb/s)



**SD**

(720x576, 248 Mb/s)



## De-interlacing

**1080i**

(1920x540, 622 Mb/s)



**1080i2/3**

(1280x540, 415 Mb/s)



**1080p2/3**

(1280x1080, 829 Mb/s)



# Subjective test conditions

## ■ Viewing conditions

- ❑ 40-inch reference full-HD LCD screen
- ❑ 1 session of 45 min.
- ❑ 145 sequences of 10 sec.
- ❑ Viewing distance = 3 x screen height (1.50m)



## ■ Assessment methodology

- ❑ Absolute Category Rating (ACR)  
with 11 levels and 5 adjectives (bad .... excellent)

## ■ Observers

- ❑ 26 non-expert viewers
- ❑ 19 to 50 years old, average 27
- ❑ Visual acuity / color blindness tested

# Video contents

---



stockholm



cross



football



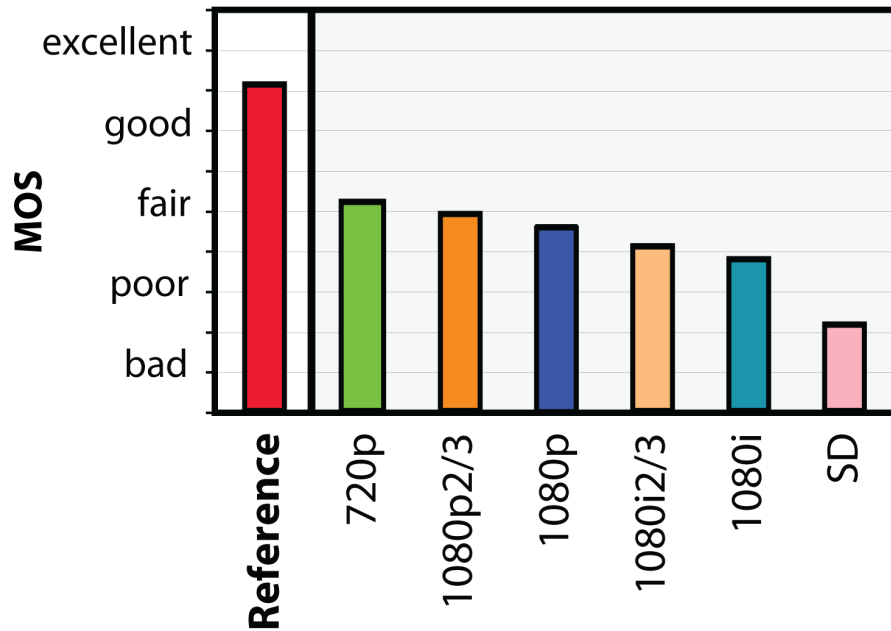
manege



canal

# Experimental results (1/4)

## 3 Mb/s

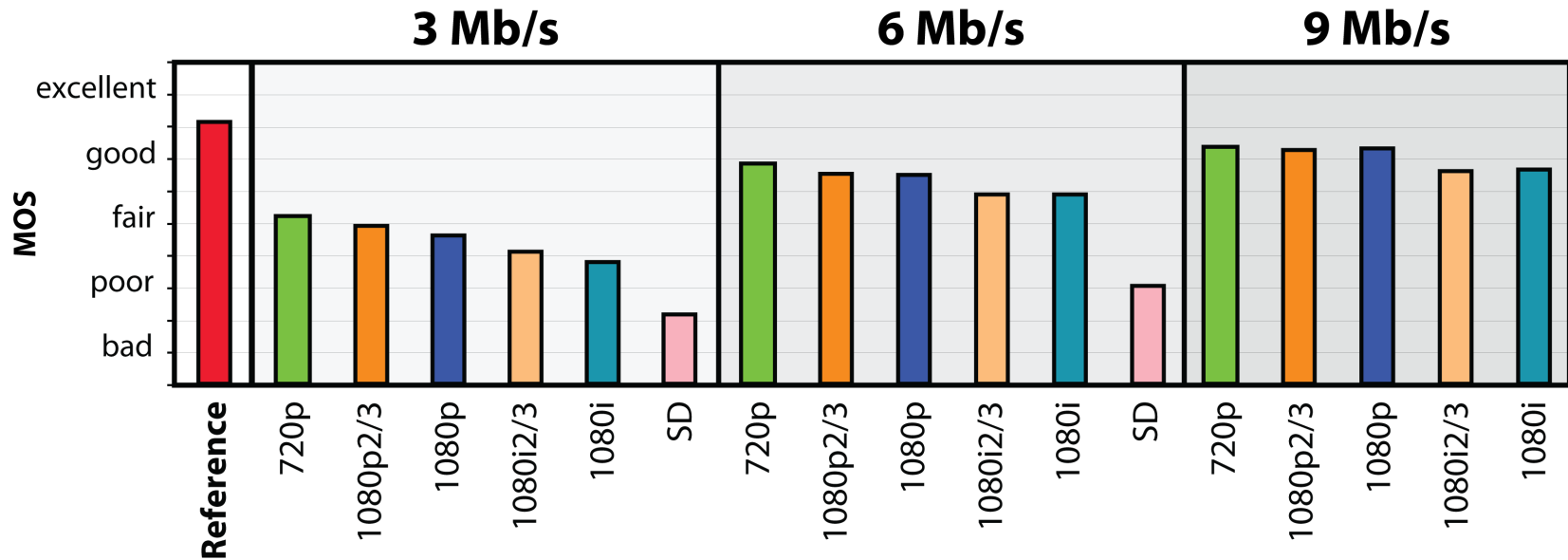


- 720p equivalent to 1080p
- Progressive preferred to interlaced
- Upscaling preferred to interlaced
- HD-formats preferred to SD



# Experimental results (2/4)

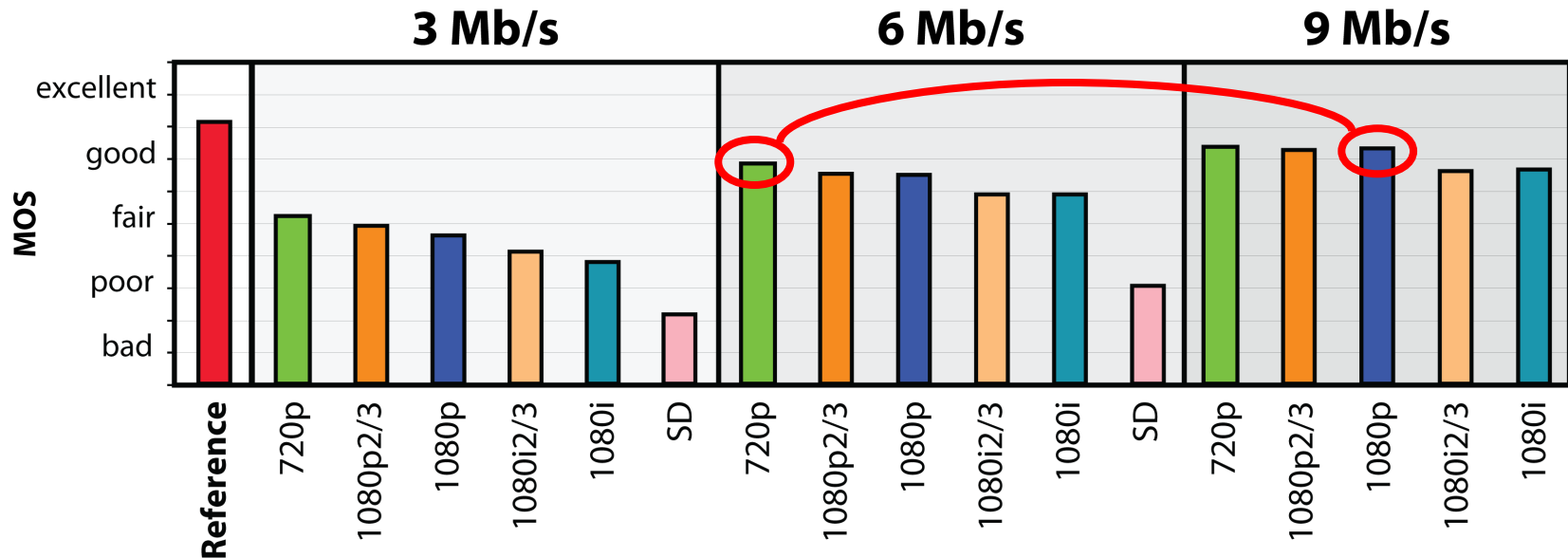
## Graphical analysis



- 720p equivalent to 1080p
- Progressive better than interlaced
- Upscaling better than interlaced
- Sub-HD better than SD

# Experimental results (2/4)

## □ Graphical analysis

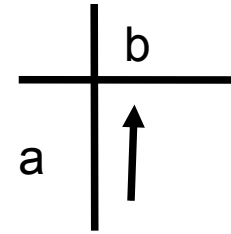


- 720p at 6Mb/s close to 1080p at 9Mb/s
- less processing power
- less bandwidth

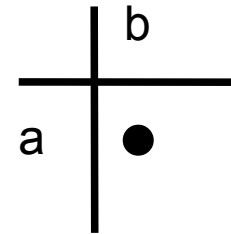
# Experimental results (3/4)

## □ Statistical analysis (3 Mb/s)

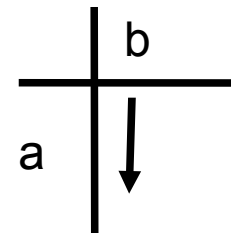
	Reference	1080p	1080i	720p	1080i2/3	1080p2/3	SD
Reference		↑	↑	↑	↑	↑	↑
1080p	↓		↑	.	.	.	↑
1080i	↓	↓		↓	↓	↓	↑
720p	↓	.	↑	.	.	.	↑
1080i2/3	↓	.	.	↓	↓	↓	↑
1080p2/3	↓	.	↑	.	.	.	↑
SD	↓	↓	↓	↓	↓	↓	.



**a** statistically better than **b**



**a** and **b** not statistically significantly different

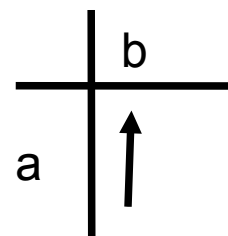


**b** statistically better than **a**

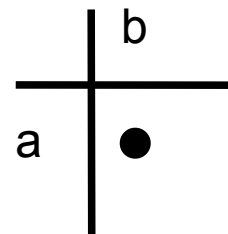
# Experimental results (3/4)

## □ Statistical analysis (3 Mb/s)

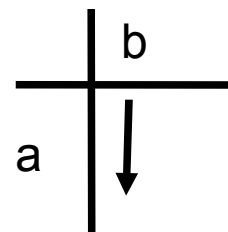
	Reference	1080p	1080i	720p	1080i2/3	1080p2/3	SD
Reference	.	↑	↑	↑	↑	↑	↑
1080p	↓	.	↑	.	.	.	↑
1080i	↓	.	.	↓	↓	↓	↑
720p	↓	.	↑	.	.	.	↑
1080i2/3	↓	.	.	↓	↓	↓	↑
1080p2/3	↓	.	↑	.	.	.	↑
SD	↓	↓	↓	↓	↓	↓	.



**a** statistically better than **b**



**a** and **b** not statistically significantly different



**b** statistically better than **a**

# Experimental results (4/4)

## □ Statistical analysis

		3 Mb/s							6 Mb/s							9 Mb/s						
		Reference	1080p	1080i	720p	1080i2/3	1080p2/3	SD	1080p	1080i	720p	1080i2/3	1080p2/3	SD	1080p	1080i	720p	1080i2/3	1080p2/3			
3 Mb/s	Reference	↓	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑	↑	↑	↓	↑	↑	↑	↑	↑		
	1080p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	720p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080p2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	SD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
6 Mb/s	1080p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	720p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080p2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	SD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
9 Mb/s	1080i	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	720p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080p2/3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	SD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080p	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
	1080i	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		

# Conclusions

---

- 720p preferred to 1080p at the same bitrate
- Progressive preferred to interlaced
- Spatial upscaling preferred to interlaced
- Upscaling with Bilinear or Lanczos filters equivalent in 10 out of 11 conditions
- SD judged to have the worst quality
- 720p at 6Mb/s close to 1080p at 9Mb/s

---

Thank you for your attention

---

Your questions are welcome!

