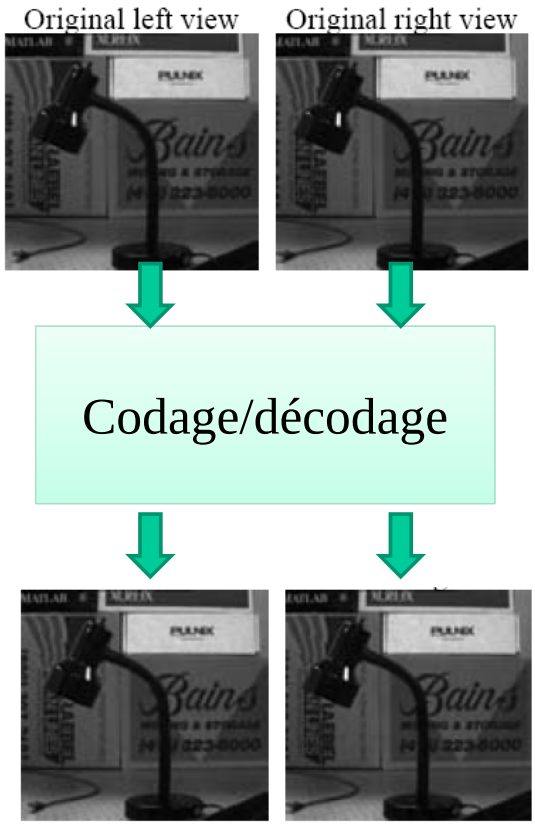
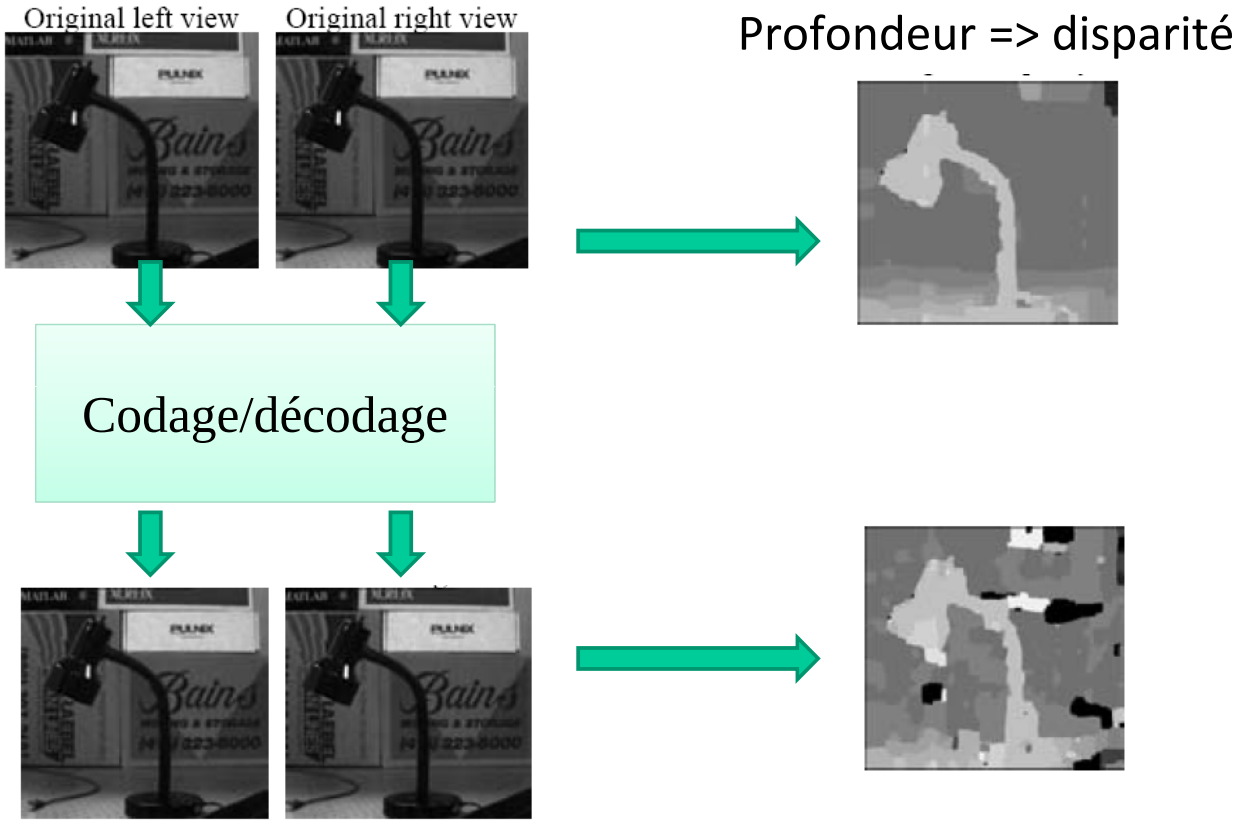
TV3D un nouveau défi pour l'évaluation de la qualité perceptuelle ?

Patrick Le Callet

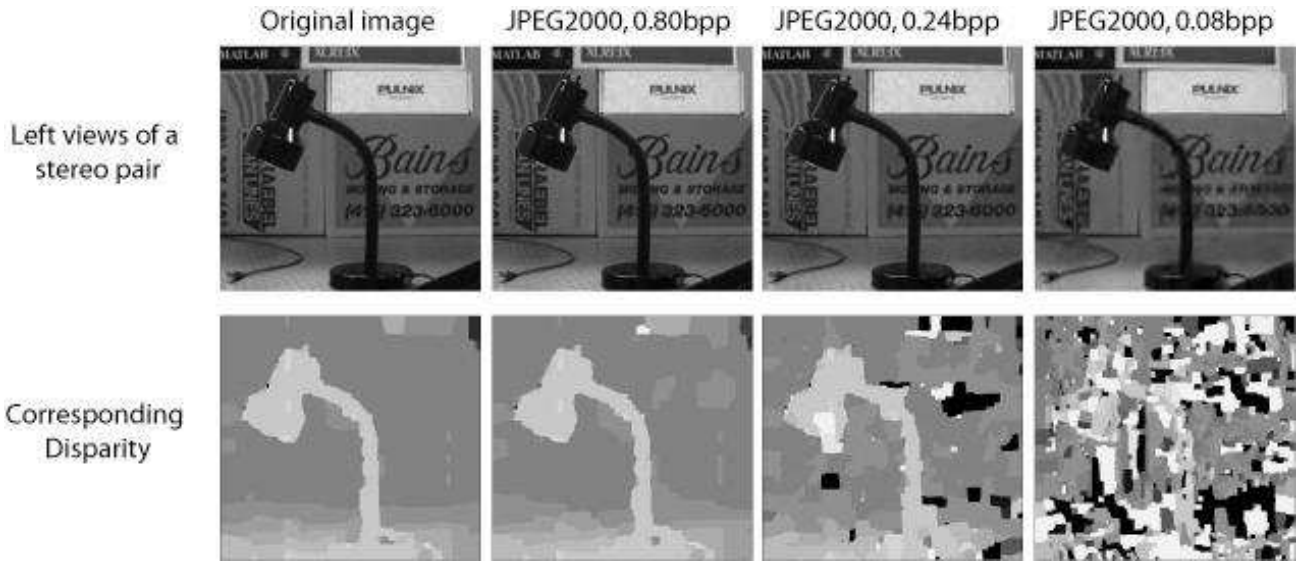
Qualité d'images stéréo



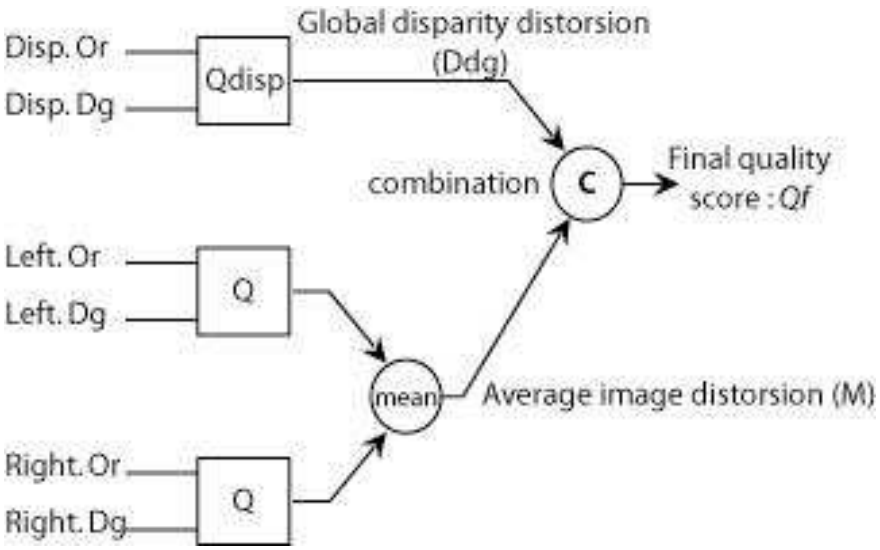
Qualité d'images stéréo



Qualité d'images stéréo



Mesure objective de qualité



Quality of stereoscopic images, Alexandre Benoit, Patrick Le Callet, Patrizio Campisi and Romain Cousseau, *EURASIP Journal on Image and Video Processing, special issue on 3D Image and Video Processing, vol. 2008, Article ID 659024, 13 pages, doi:10.1155/2008/659024, 2008.*

Evaluation subjective

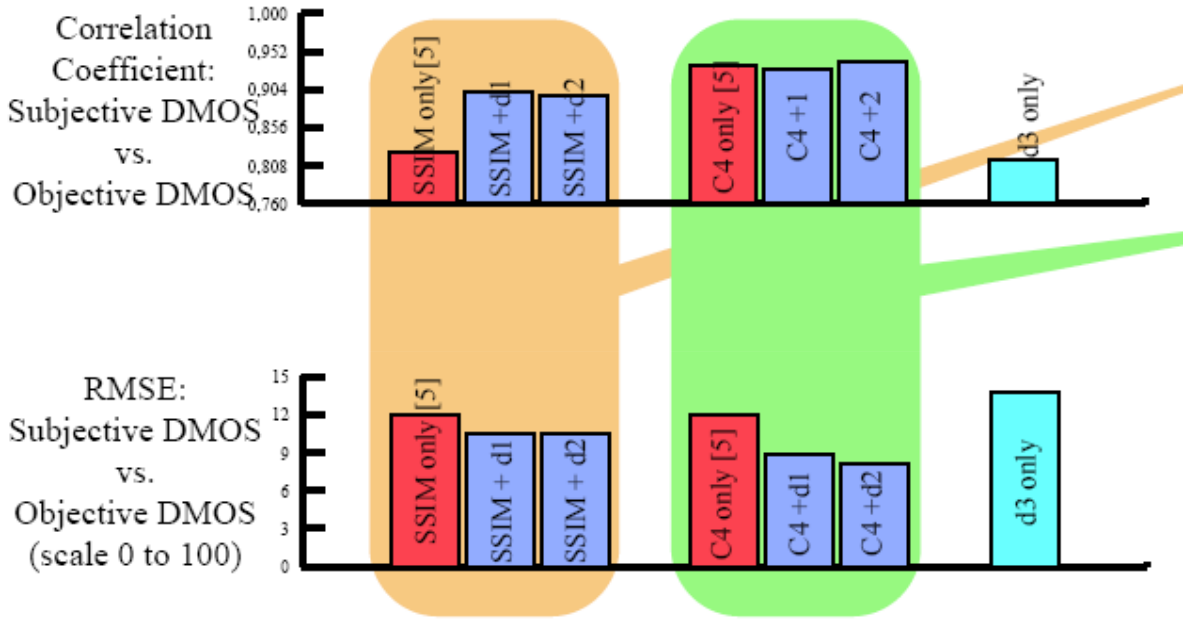
Conditions Rec. ITU

notation: qualité, SAMVIQ

6 SCR

10 HRC (JPEG, J2K)

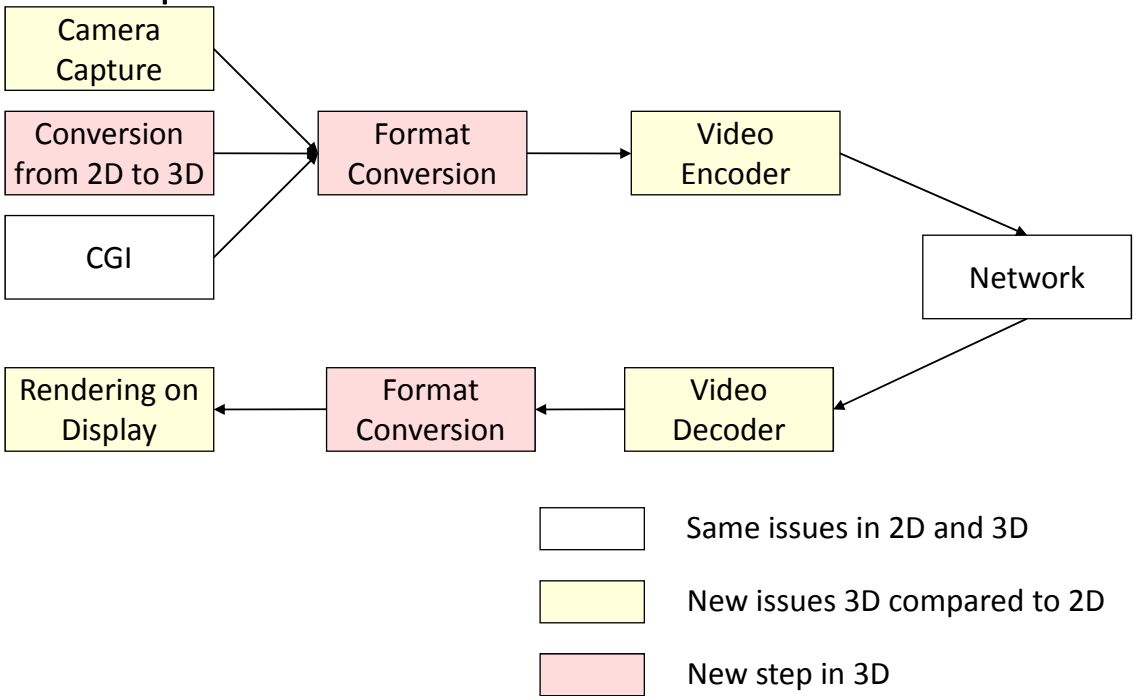
Performances ?



Qualité S-3D: nouvelles problématiques

Pour quelle condition ? => HRC ? Nouveaux artefacts ?

la diffusion E2E de contenu 3D est un défi …qui n'est pas une simple extension du cas 2D



Qualité S-3D: nouvelles problématiques

Qualité & 3D => que mesurer ?

la S-3D doit être acceptée par les observateurs pour être un succès.

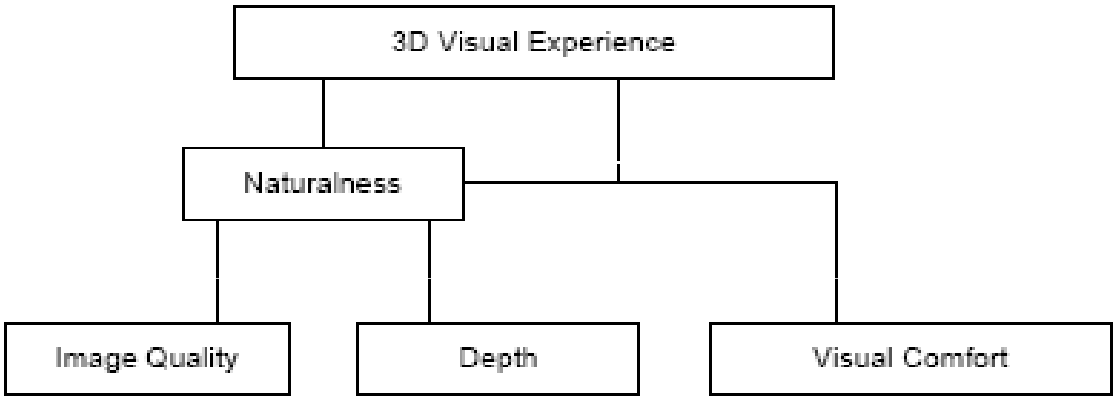
…certains prévoient déjà la mort

R. Ebert, “Why i hate 3-d (and you should too),” Newsweek, May 2010. [Online]. Available: http://www.newsweek.com/2010/04/30/why-i-hate-3-d-and-you-should-too.html

M. Kermode, “Come in number 3d, your time is up,” BBC News, December 2009. [Online]. Available: http://www.bbc.co.uk/blogs/markkermode/2009/12/come in number 3d your time is.html

3D Visual Experience (seuntiëns 2006)

Qualité & 3D => multidimensionnel



+ Visual fatigue ?

=> Vers la QoE, comment la mesurer avec des observateurs ….ensuite peut être objectivement

Profondeur: La S-3D actuelle «trompe« notre perception

Binocular cues

binocular disparity and vergence

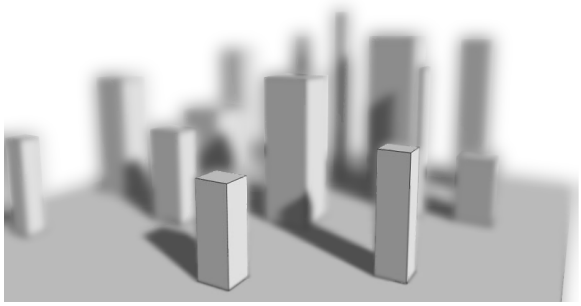
…but also monocular cues

accommodation, blur

Texture gradient, shadows

perspective, relative size

motion parallax



Indices de profondeur…sensibilité

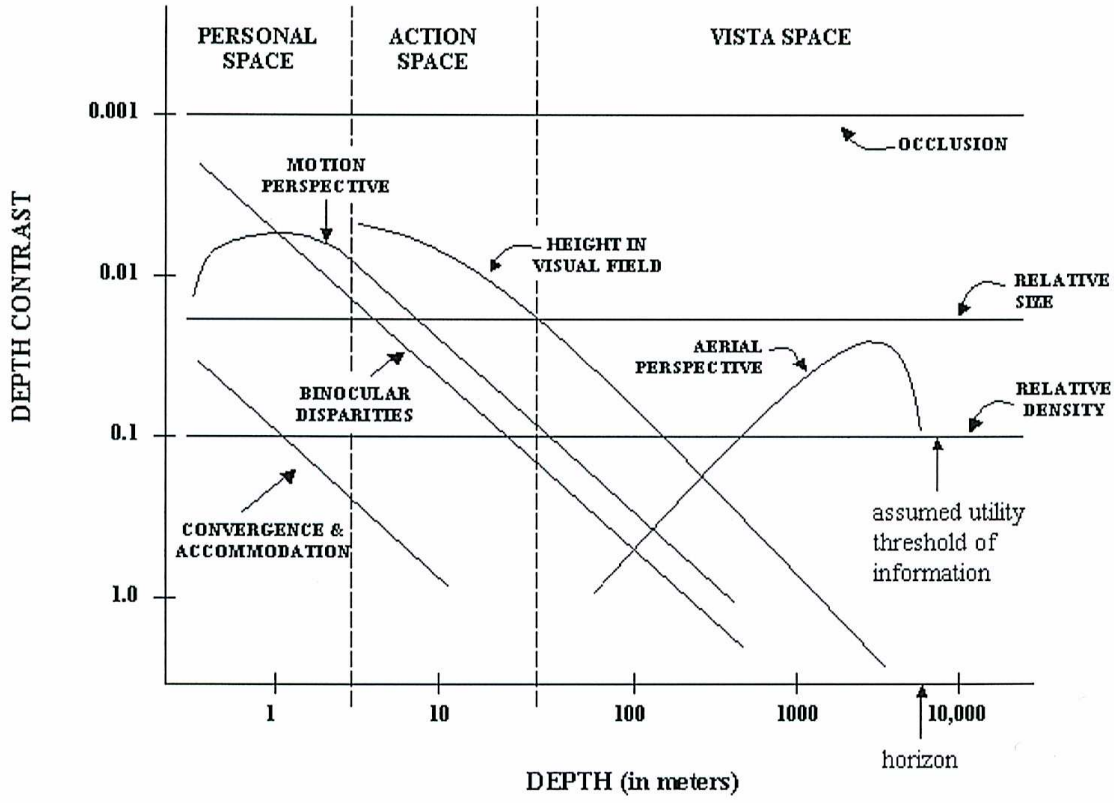


Figure adapted from Cutting & Vishton 1995

La S-3D actuelle «trompe« notre perception

Combinaison des indices de profondeurs:
corrélation vs ambiguïté …

dominance d'indice

réinterprétation d'indice

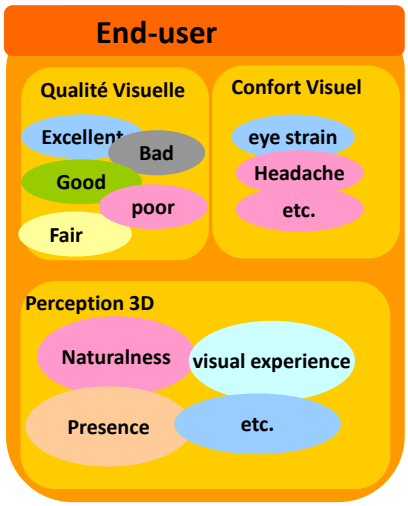
Question :

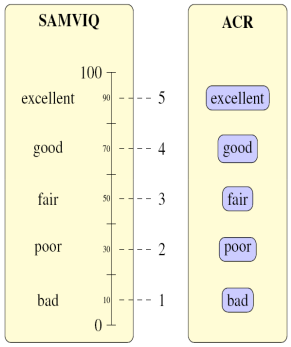
Cue enhancement without reliability with others => cognitive load ?

Mesurer la qualité d'expérience 3D

Challenge: mesurer la QoE

Multidimensionnel: évaluation de plusieurs attributs





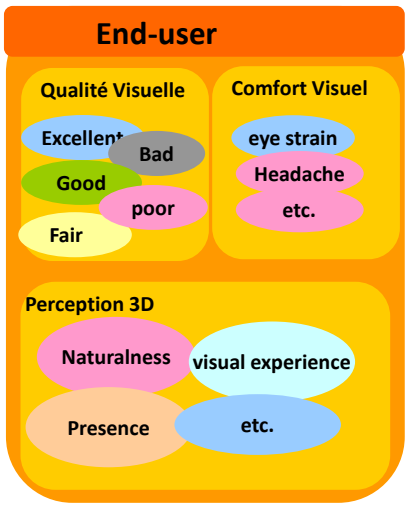
qualité visuelle

profondeur

confort visuel

*New requirement of subjective video quality assessment methodologies for 3DTV - VPQM 2010
Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet - , Orange labs R&D - IRCCyN

Challenge: mesurer la QoE



questionnaries

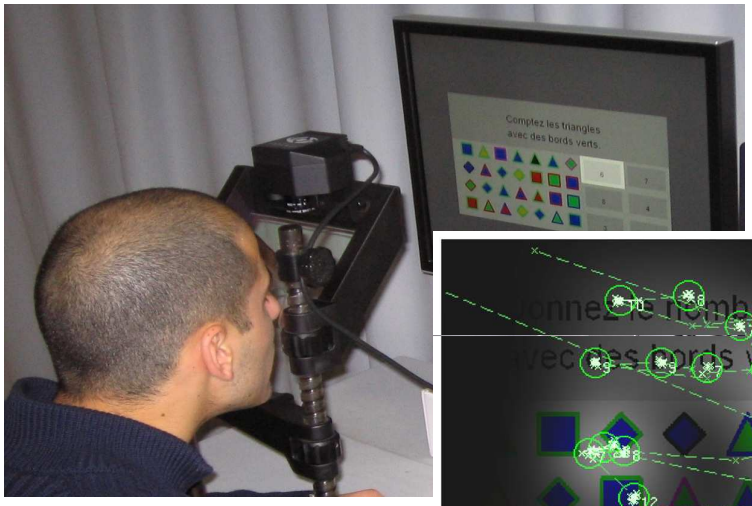
optometry

eyetracking

EEG - EMG

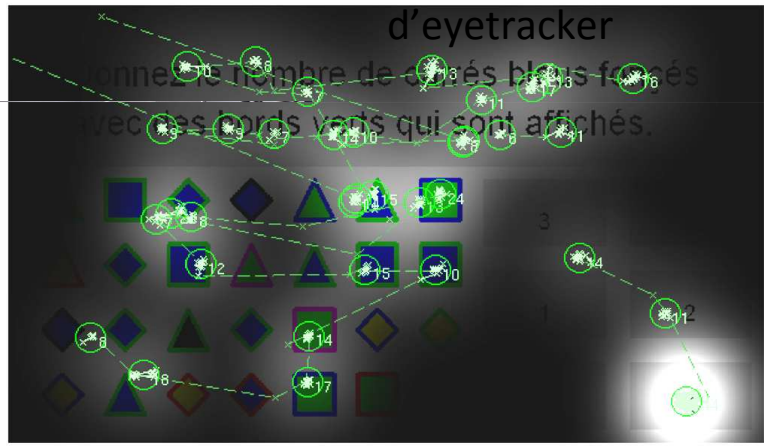
*New requirement of subjective video quality assessment methodologies for 3DTV - VPQM 2010
Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet - , Orange labs R&D - IRCCyN

Impact sur la performance (pre et post 3D)



mesure de la performance:

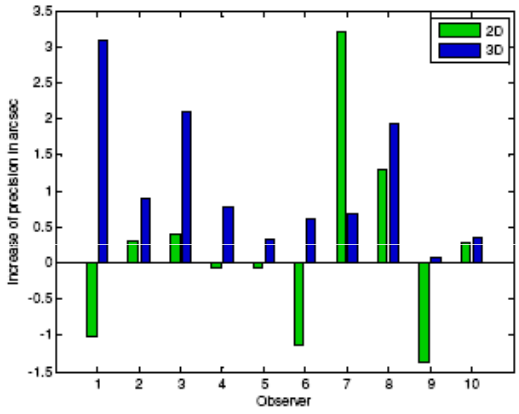
Question+réponse => Utilisation d'eyetracker



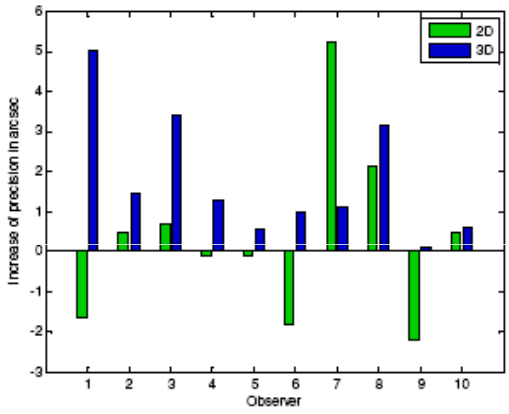
Influence of autostereoscopic 3D displays on subsequent task performance- Stereoscopic Displays and Applications 2010
Marcus Barkowsky, Patrick Le Callet - IRCCyN

Impact sur la performance (pre et post 3D)

mesure de la performance: expérience de psychophysique + optométrie



Accuracy increase for 75% correct detection [arcsec]



Accuracy increase for 92% correct detection [arcsec]

augmentation des performances alors que les observateurs rapportent des « symptômes » d'inconfort (questionnaire)

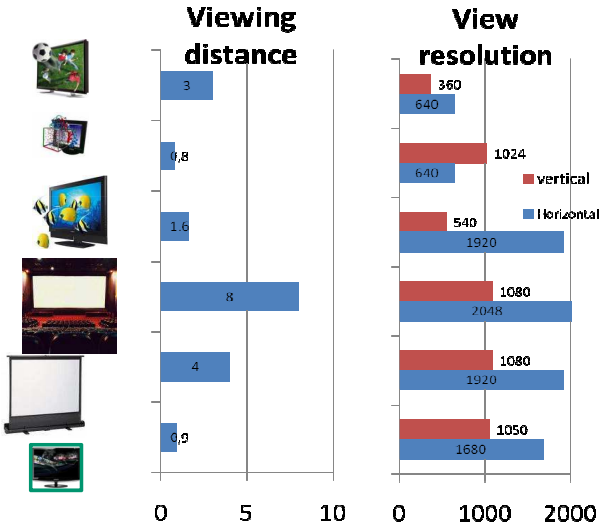
Is visual fatigue changing the perceived depth accuracy on an autostereoscopic display?
Marcus Barkowsky, Romain Cousseau, Patrick Le Callet- Stereoscopic Displays and Applications 2011

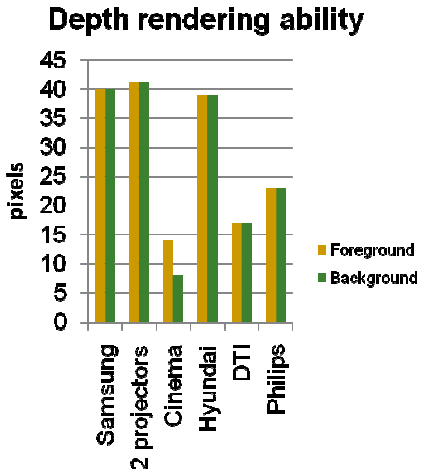
Challenge: les conditions de test

exemple: l'écran

en 2D on dispose d'écrans « transparents » (cas particulier LCD)

Mais c'est loin d'être le cas en S-3D !





New requirement of subjective video quality assessment methodologies for 3DTV - VPQM 2010
Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet - , Orange labs R&D - IRCCyN

Problème des écrans (2)

- Autres problèmes technologiques
  - Crosstalk
  - Flickering due to ambient lighting with shutter glasses
  - Post processing & rendering
- Problèmes „facteurs humains“
  - Fixed viewing distance necessary
  - Influence of training in 3D viewing

Quelques questions et défis

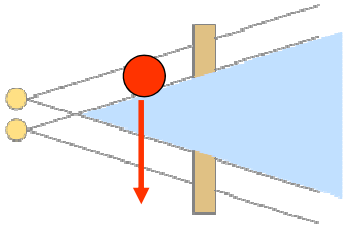
Capture (1/2)

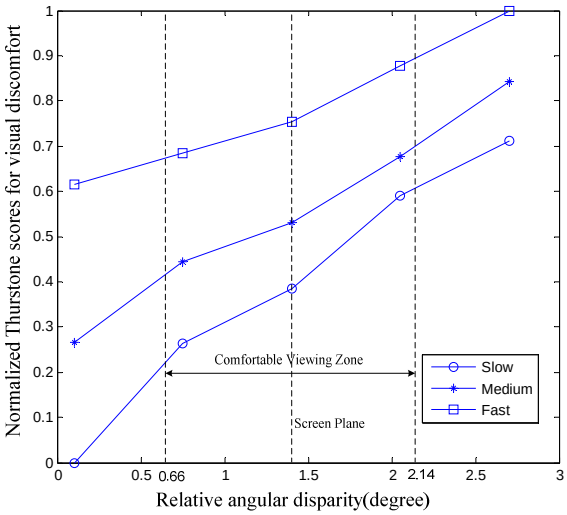
- Challenges in camera capturing:
  - Synchronization (shutter, zoom, focus, …)
  - Camera alignment (toed-in, …)
  - Camera calibration (geometry, color, focus, …)

⇒Relation avec la QoE ?

Capture (2/2)

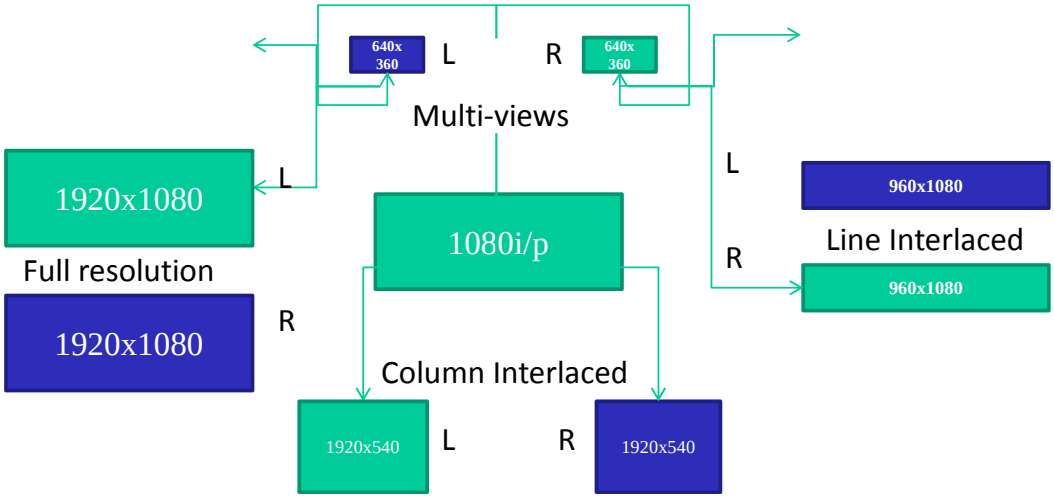
- Focus point different from viewer‘s attention
- Visual fatigue due to moving objects in the foreground of the display





STUDY ON VISUAL DISCOMFORT INDUCED BY STIMULUS MOVEMENT AT FIXED DEPTH ON STEREOSCOPIC DISPLAYS USING SHUTTER GLASSES J. Li, M. Barkowsky, J. Wang, and P. Le Callet, to appear in IEEE DSP 2011

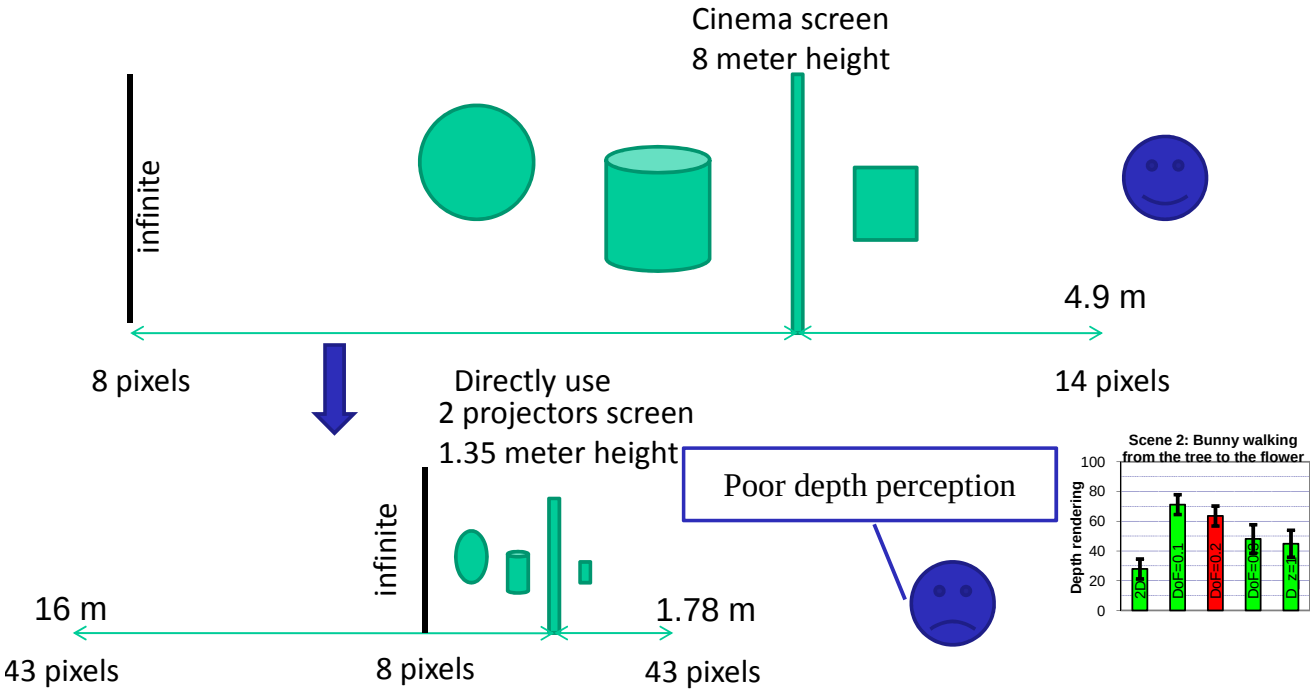
S-3D : la jungle des formats



Perte de résolution=> perte de détails, gradients

Influence of depth rendering on the quality of experience for an autostereoscopic display. influence of depth rendering on the quality of experience for an autostereoscopic display.
M . Barkowsky , R . Cousseau , P . Le Callet , IEEE International Workshop on Quality of Multimedia Experience, 2009

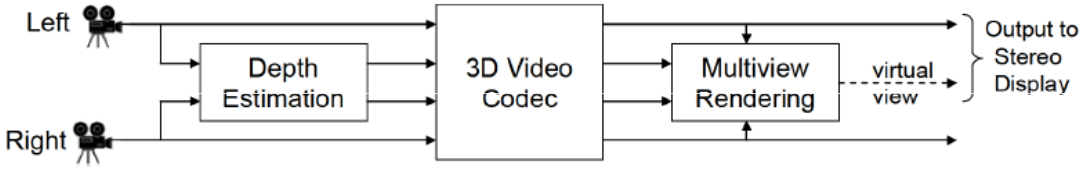
3D QoE: postprroduction de la salle cinema au home cinema ?

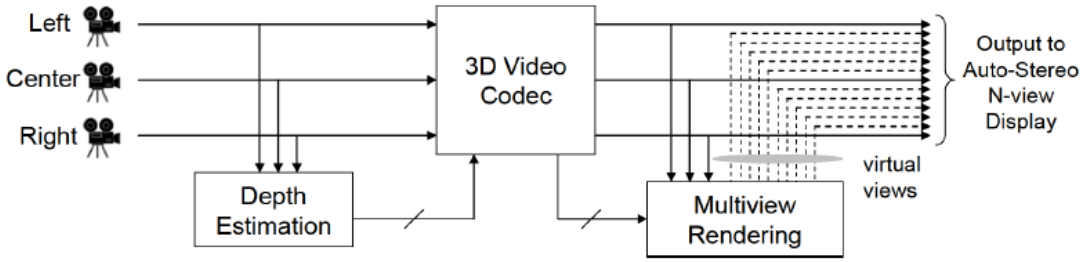


New stereoscopic video shooting rule based on stereoscopic distortion parameters and comfortable viewing zone – SDA 2011
Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet - , Orange labs R&D - IRCCyN

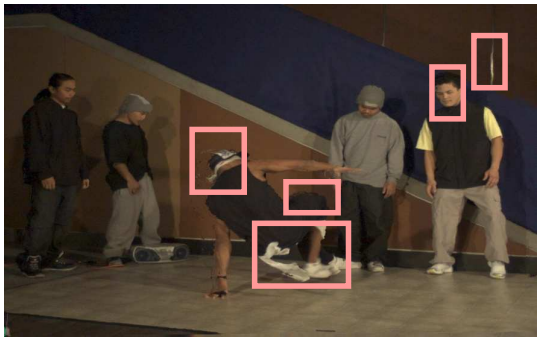
Conversion (contexte FTV)

- Conversion avec pertes
  - Depth Image Based Rendering (DIBR)
  - Depth Estimation from single or multiple viewpoints





DIBR: artefacts typiques






DIBR: les métriques de qualité actuelles sont inutiles

	PSNR	SSIM	MSSIM	VSNR	VIF	VIFP	UQI	IFC	NQM	WSNR	PSNR HVSM	PSNR HVS
CC	40.5	-14.5	-8.9	-21.2	-22.3	-22.9	-25.9	-22.8	42.6	39.6	37.1	37.1

Table 3. Correlation coefficients between subjective and objective scores in percentage.

	PSNR	SSIM	MSSIM	VSNR	VIF	VIFP	UQI	IFC	NQM	WSNR	PSNR hsvm	PSNR hsv
PSNR		83.9	79.6	87.3	77.0	70.6	53.6	71.6	95.2	98.2	99.2	99.0
SSIM	83.9		96.7	93.9	93.4	92.4	81.5	92.9	84.9	83.7	83.2	83.5
MSSIM	79.6	96.7		89.7	88.8	90.2	86.3	89.4	85.6	81.1	77.9	78.3
VSNR	87.3	93.9	89.7		87.9	83.3	71.9	84.0	85.3	85.5	86.1	85.8
VIF	77.0	93.4	88.8	87.9		97.5	75.2	98.7	74.4	78.1	79.4	80.2
VIFP	70.6	92.4	90.2	83.3	97.5		85.9	99.2	73.6	75.0	72.2	72.9
UQI	53.6	81.5	86.3	71.9	75.2	85.9		81.9	70.2	61.8	50.9	50.8
IFC	71.6	92.9	89.4	84.0	98.7	99.2	81.9		72.8	74.4	73.5	74.4
NQM	95.2	84.9	85.6	85.3	74.4	73.6	70.2	72.8		97.1	92.3	91.8
WSNR	98.2	83.7	81.1	85.5	78.1	75.0	61.8	74.4	97.1		97.4	97.1
PSNR hsvm	99.2	83.2	77.9	86.1	79.4	72.2	50.9	73.5	92.3	97.4		99.9
PSNR hsv	99.0	83.5	78.3	85.8	80.2	72.9	50.8	74.4	91.8	97.1	99.9	

Table 2. Correlation coefficients between objective metrics in percentage.

Towards a new quality metric for 3D synthesized views assessment – en relecture IEEE trans. on CSVT

Emilie Bosc, R.pépion, P. Le Callet, M. Köppel, P. Ndjiki-Nya, M. Pressigout, L. Morin

Codage et transmission

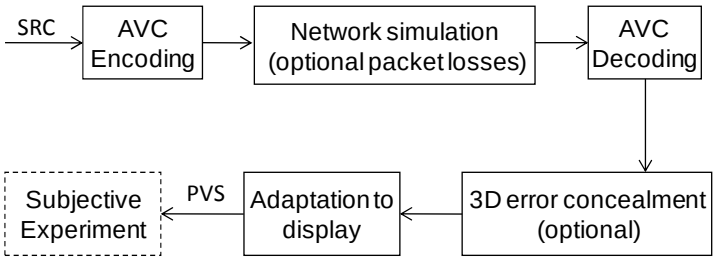
La grande tentation: Asymetric stereoscopic conditions

asymetric coding

Transmission impairment

- Fusion binoculaire et rivalité
  - Codage Asymmetrique réduit le débit à qualité visuelle équivalente mais stresse la rivalité binoculaire ➔ visual fatigue
  - Problème à considerer dans le cas d'erreur de transmission

Comparaison des stratégies d'error concealment



❖ 20 processes (HRCs), 200 PVS

❖ Concealment method
  A. H.264
  B. Frame freezing
  C. Reduced playback speed
  D. Switch to 2D presentation

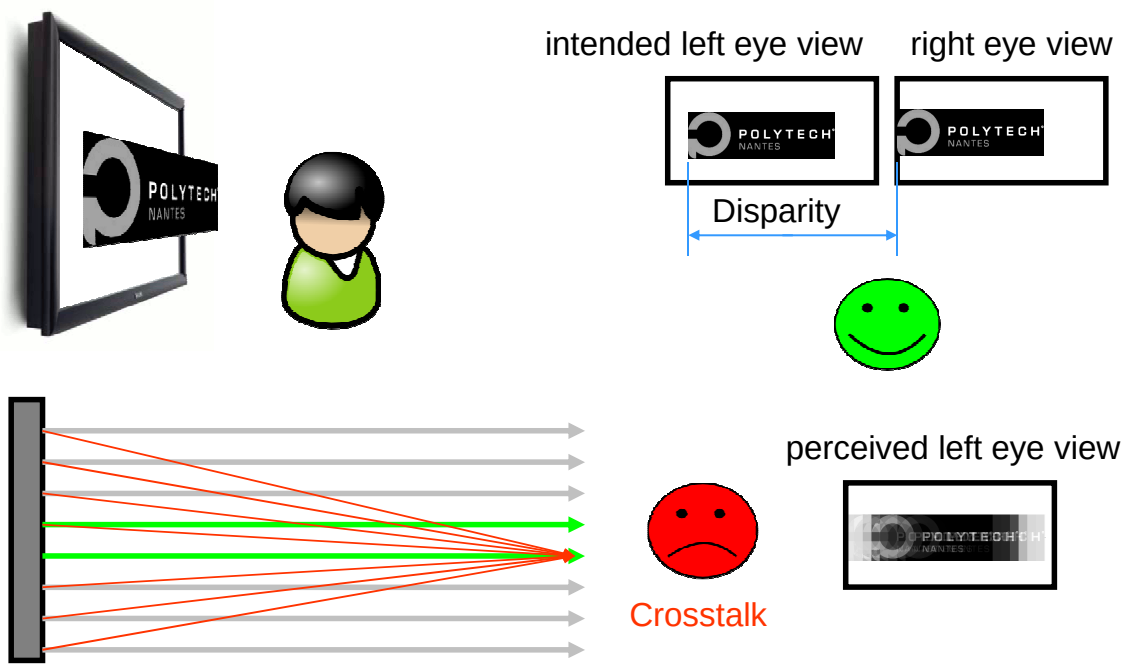
✓ Best: Switch to 2D

✓ Worst: Freeze, no big diff. D&C

✓ Worst@ heavy burst H.264

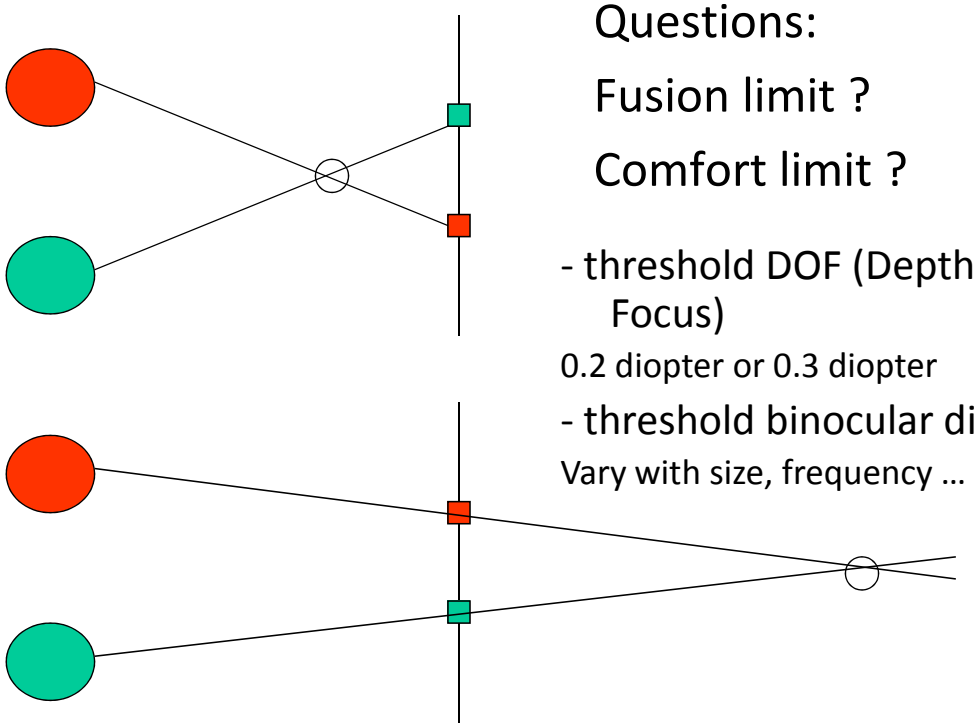
SUBJECTIVE QUALITY ASSESSMENT OF ERROR CONCEALMENT STRATEGIES FOR 3DTV IN THE PRESENCE OF ASYMMETRIC TRANSMISSION ERRORS – IEEE PV 2010
M. Barkowsky, K.Wang, R. Cousseau, K. Brunnström, R. Olsson, P. Le Callet

TV3D : crosstalk



*Crosstalk Measurement and Mitigation for Autostereoscopic Displays- SPIE 3D image processing 2010 Marcus Barkowsky, Patrick Le Callet, Patrizio Campisi, Vito Rizzo- IRCCyN Lab, Nantes, Università degli Studi „Roma Tre“

vergence/accommodation conflict



Questions:

Fusion limit ?

Comfort limit ?

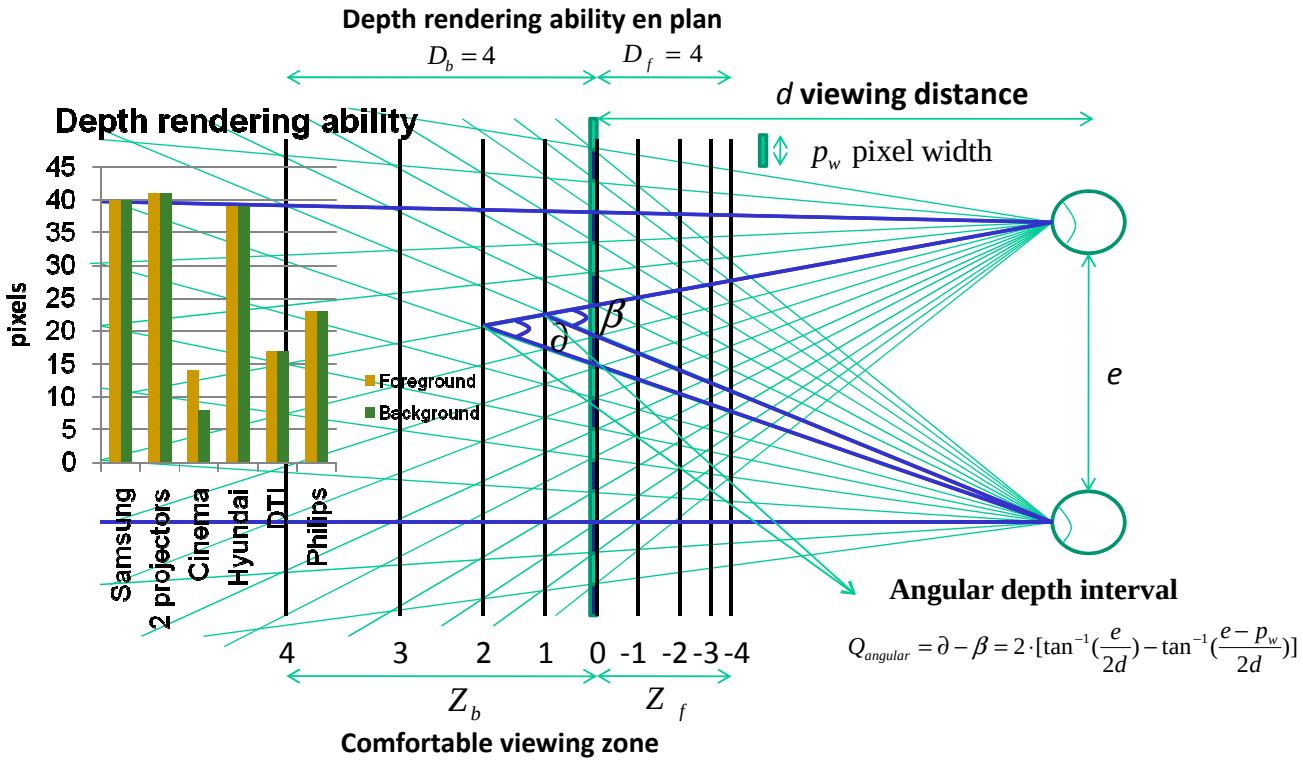
- threshold DOF (Depth Of Focus)

0.2 diopter or 0.3 diopter

- threshold binocular disparity

Vary with size, frequency …

depth rendering



*New requirement of subjective video quality assessment methodologies for 3DTV - VPQM 2010
Wei Chen, Jérôme Fournier, Marcus Barkowsky, Patrick Le Callet - , Orange labs R&D - IRCCyN

vergence/accommodation : challenges and solutions …

« Ramener » les ROI dans la zone de comfort visuel

Problème des sous titrages, EPG …

Filtrage pour limiter les ambiguïtés et faciliter la fusion binoculaire

Plus qu'en 2D, l'attention visuelle peut être très utile dans le contexte s-3D pour améliorer la QoE et en particulier le confort visuel

The Importance of Visual Attention in Improving the 3D-TV Viewing Experience: Overview and New Perspectives - Q.Huynh-Thu, M.Barkowsky and P. Le Callet to appear in IEEE trans. On Broadcasting, 2011

mais … les mécanismes de l'attention visuelle associée au media s-3D sont encore mal connus

Take away messages …

- S-3D et évaluation subjective …ce qui reste à définir
  - Display: exigences minimales et caractérisation
  - Standardizsation des environnements de visualisation
  - Mesures fiables des différentes dimensions:
    - Profondeur, qualité globale, …Depth impression
    - Confort, fatigue …

Take away messages …

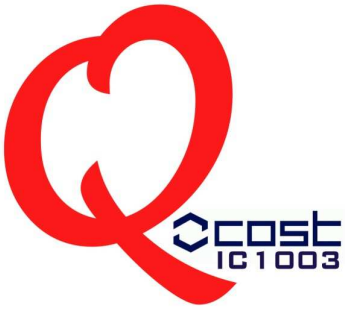
- Vers les métriques objectives
  - Besoin de données issues d'évaluations subjectives fiables
  - Considérer les nouveaux types d'artefacts liés au 3D
  - Modélisation des processus de fusion perceptuelle et mécanismes de haut niveau
  - Nécessité d'avoir accès au signal affiché (après algoritmes de rendu), modélisation d'écran

VQEG (Video Quality Expert Group)

un groupe: 3DTV

Des activités:

- Testplan crosstalk
- Travail sur les méthodologies d'évaluation subjective

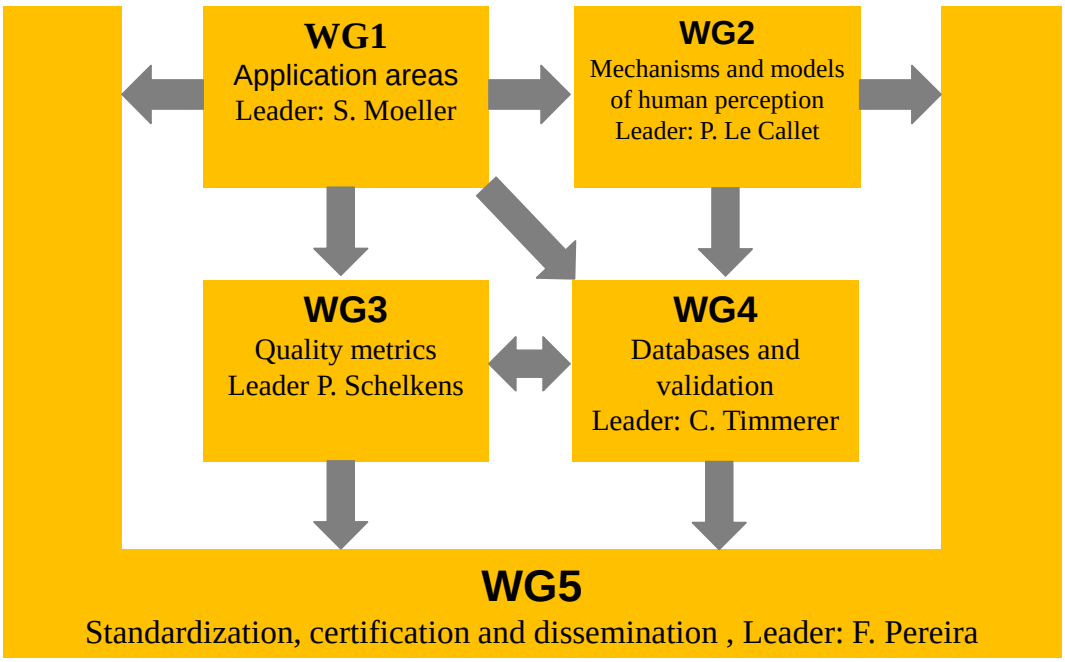


COST Action IC1003 - QUALINET
European Network on Quality of Experience in Multimedia Systems and Services

QUALINET objectives

- Coordination of multidisciplinary QoE research in Europe
- Strengthening dissemination efforts through already established, and new initiatives (QoMEX, special events, books, journals, …)
- Strengthening interaction between academia and industry (industrial forum, STSM, …)
- Strengthening educational efforts in QoE (summer schools, Ph.D. events, exchange of young researchers with STSM, …)
- Coordinated contribution to international standards (ISO, ITU-T, VQEG, …)
- Coordination between multimedia evaluation laboratory clusters at partner premises (cross-validation, reference laboratories…)
- Study and initiation of certification mechanisms for multimedia products and services (pilot projects with industrial partners, …)
- Creation of a sustainable QUALINET beyond the period of funding

Technical Working Groups



- Chair: T. Ebrahimi
- Co chair: A. Perkins

- 18 pays