



Cyberspatial Media for Managing Attention and Privacy: 3D Computer Graphics and Audio

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Current research foci

- ⊕ **interactive multimedia**; 対話型 マルチメディア
- ⊕ **telecommunications semiotics; user interfaces**; ユーザ インタフェース
- ⊕ **mixed/augmented reality/virtuality**; 現実性増加機能
- ⊕ **virtual reality**; バーチャルリアリティー (仮想現実)
- ⊕ **ubicom**; コピキタスコンピューティング
- ⊕ **groupware, CSCW (computer-supported collaborative work), MUVes (multiuser virtual environments)**; コンピュータ支援共同作業
 - **narrowcasting**; ナローキャスティング
- ⊕ **spatial media**; スペーシャルメディア
 - **stereography**; 3次元CG
 - **cyberspatial audio: spatial sound and stereotelephony**; 立体音響
 - **multichannel (polyphonic) spatial sound**
 - **computer music**; コンピューターミュージック
 - **mocap (motion capture) & motion display (Internet Chair rotary motion platform)**
- ⊕ **digital typography**; デジタルタイポグラフィ
- ⊕ **mobile (nomadic, portable) computing**; 携帯コンピューティング

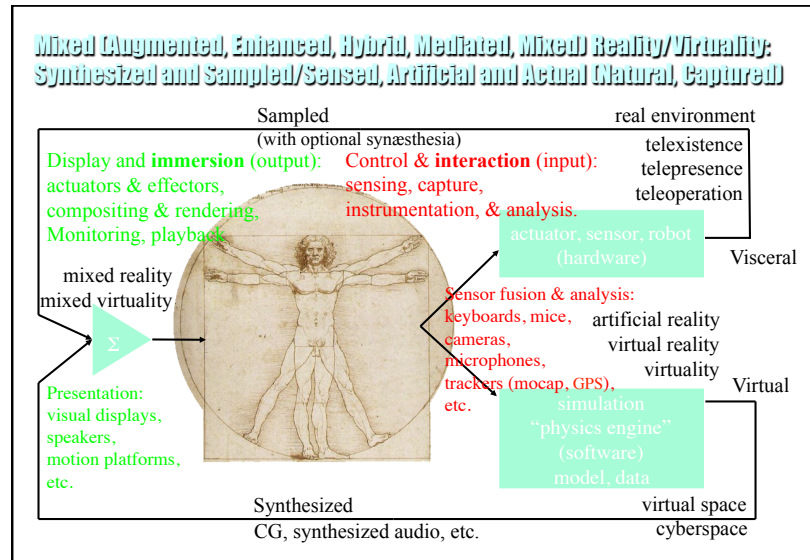
スペーシャルメディア

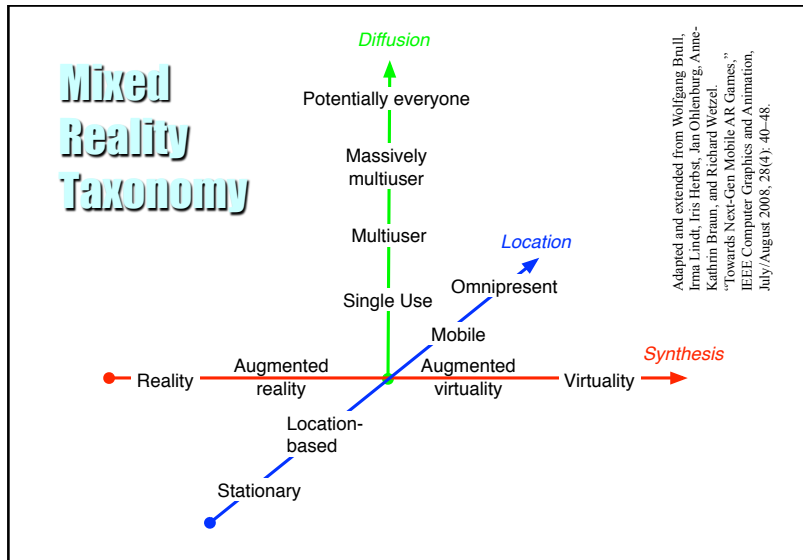
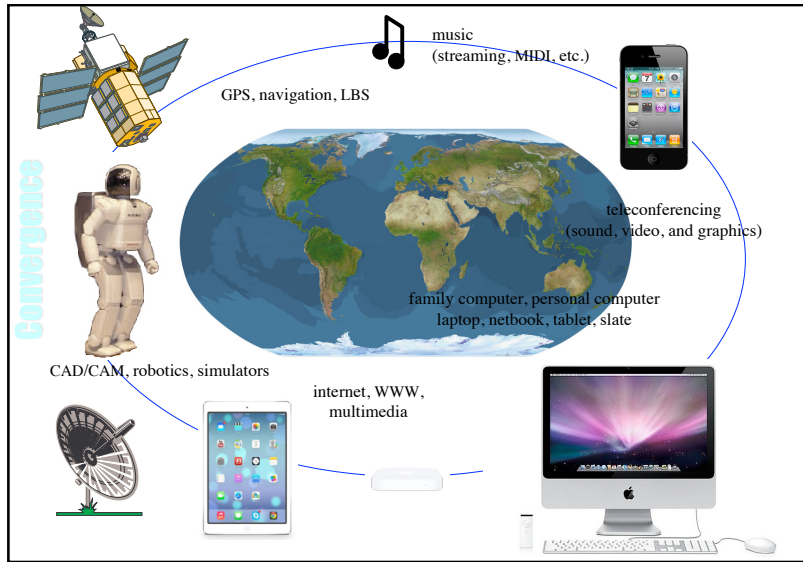
Sp^ae^cial: Special and Spatial

- ⊕ **Special: 特別**
- ⊕ **Spatial: 空間的**



www.u-aizu.ac.jp/~mcohen/spatial-media
arts.u-aizu.ac.jp

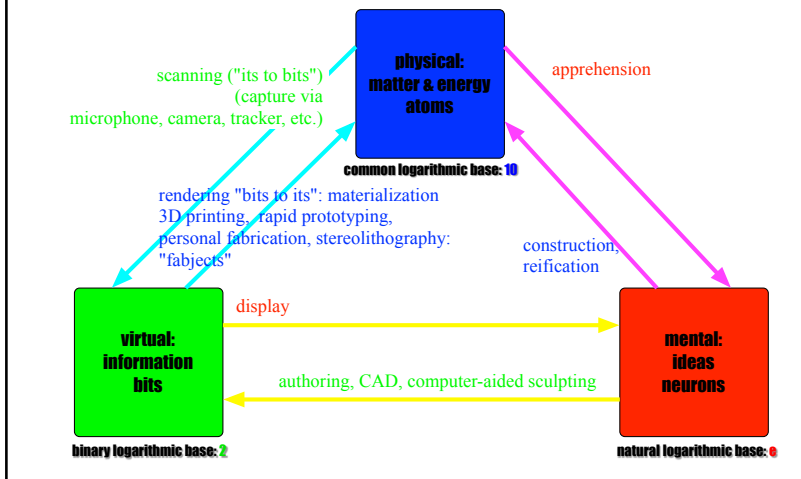




Audio and visual displays along private→public continuum across spatial separation and social intimacy:
音声、画像再生方式と視聴対象者

Proxemic Context	Users	Architecture	Audio Display	Visual Display
Intimate	1	headset, wearable computer	eartop, headphones, ear buds, mobile phone	eyetop, HWD (head-worn display), HMD (head-mounted display), mobile phone
Individual, Personal	1	chair	"nearphones"	laptop display, desktop monitor, smartphone, tablet
Interpersonal	2-3	couch or bench	multichannel crosstalk-cancelled speakers (ex.: stereo dipole)	HDTV, "fishtank VR," NEC VisionDome, workbench
Multipersonal, Familiar	2-10	vehicle, spatially immersive display, home theater (e.g., Cave, Cabin)	surround sound (ex.: Ambisonics, WFS, 5.1, 7.1, etc.)	projection (ex.: Cave™ or Cabin™)
Social	100	club, theater, "reality centers"	speaker array (ex.: VBAP, WFS, HOA)	large-screen display (ex.: IMAX)
Public	1000s	stadium, concert arena	public address	(ex.: jumbotron)

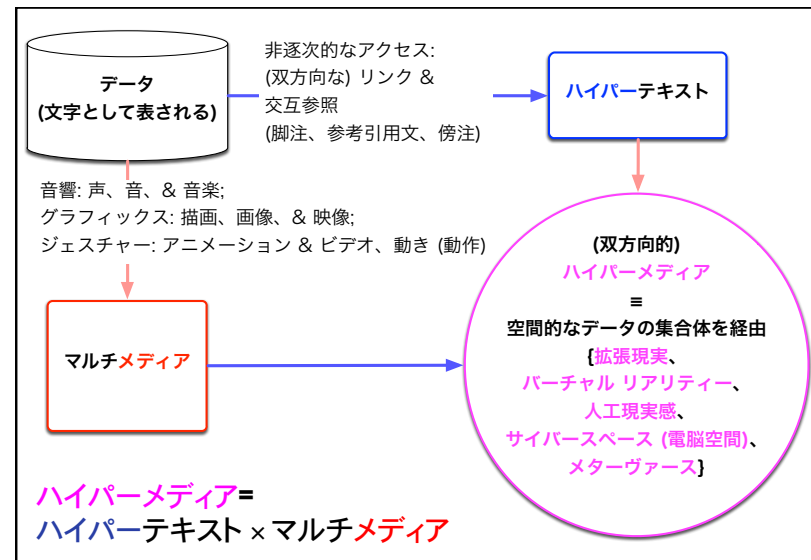
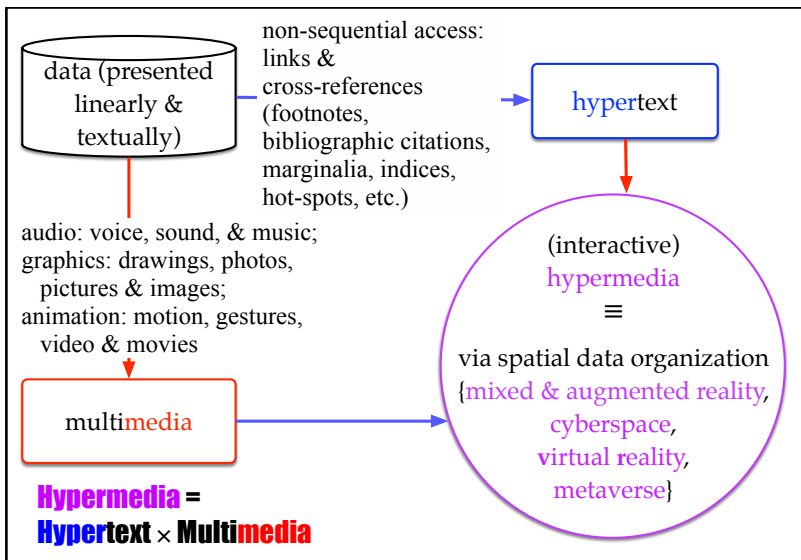
"Tangible Bits" taxonomy: Brain, Body, & Bytes

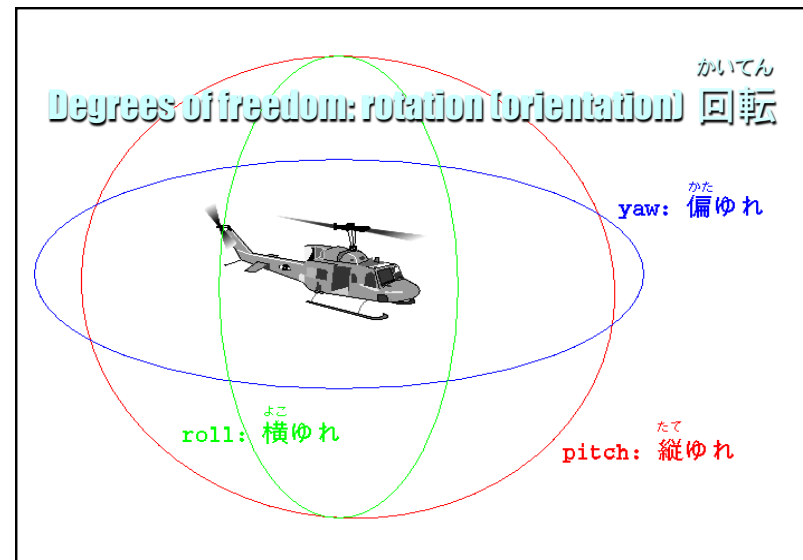
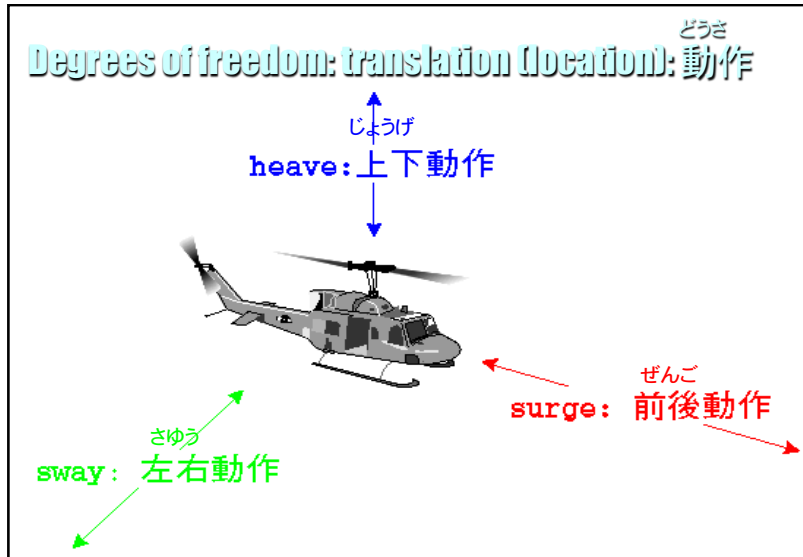


Interaction with the world; 世界との相互作用

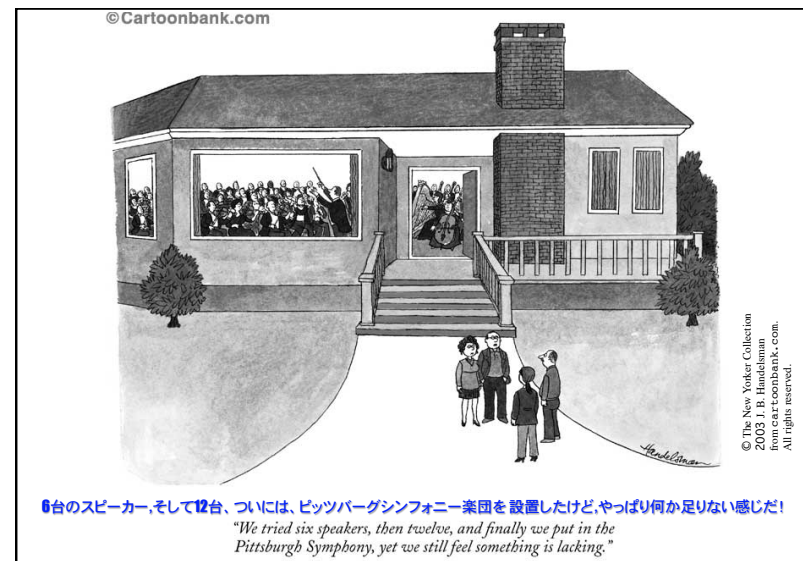
- Sampling & Interrogation or Conversation; 会話
- (Selection &) Manipulation; 操作
- Locomotion; 移動

Terry Winograd
www.designinginteractions.com/interviews/TerryWinograd

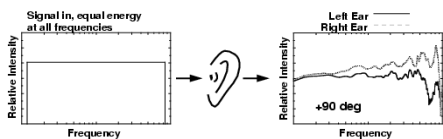
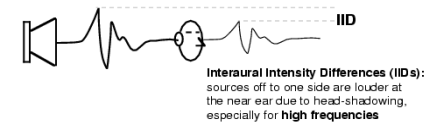
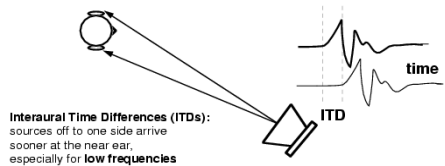




Position						
Static (Posture, Pose)		Dynamic (Gesture) Spatial Degrees-of-Freedom				
Location (displacement)	Scalar	Translation Camera Motion	Directions (Force)	Along axis	Perpendicular to plane	
lateral (transverse breadth or width)	abscissa x	sway: 左右 track ("crab")	left ↔ right <side-to-side>	x	median (sagittal)	
frontal (longitudinal depth)	ordinate y	surge; 前後 dolly	out, back (aft): retreat (drag) ↔ <forwards & backwards> in, forth (fore): advance (thrust)	y	frontal (coronal)	
vertical (height)	altitude z	heave; 上下 boom ("crane")	up: ascend (lift) ↓ down: descend (weight)	z	horizontal (transverse)	
Orientation or Attitude		Rotation; 回転			About axis	In plane
elevation, inclination	φ	pitch (tumble, flip); 縦方向 tilt	climb/dive	x	median (sagittal)	
(barrel roll)	ψ	roll (bank, flop); 横方向 (roll)	left/right	y	frontal (coronal)	
azimuth	θ	yaw (whirl, twist); 偏方向 pan	CCW/CW	z	horizontal (transverse)	
Location and Orientation		Translation and Rotation			Axis	In plane
focal pivot "inspection gesture"	x, y, θ	orbit with phase-locked attitude: "spin-around"	CCW/CW	z	horizontal (transverse)	



Primary Localization Cues



Source: Elizabeth M. Wenzel
NASA Ames Research Center

Duplex Theory for Binaural Cues

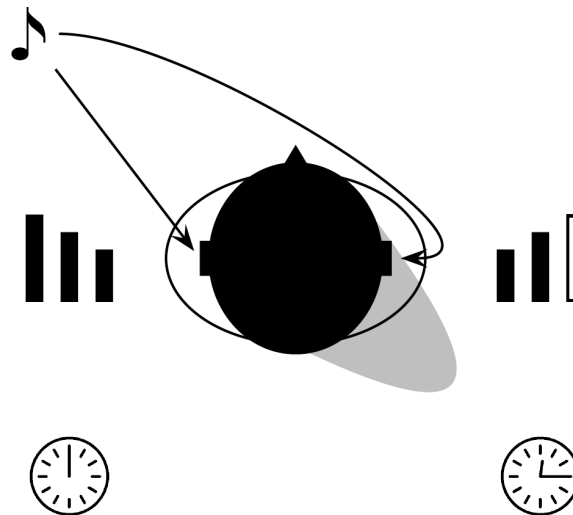
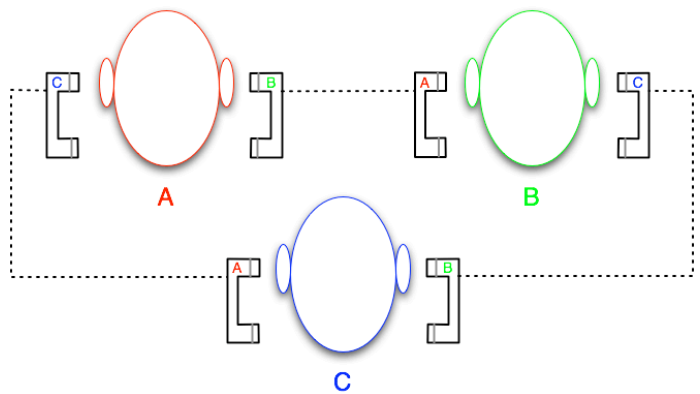


Figure by Julian Villegas, Michael Cohen and Julian Villegas. Applications of audio augmented reality: Wearable, everywhere, anytime, & aware. In Woodrow Barfield and Thomas Caudell, editors, *Fundamentals of Wearable-Computer and Augmented Reality, chapters 2, pages 309-330.* Morgan Kaufmann Associates, Mahwah, NJ, USA, second edition, in press (2015). ISBN 0-8058-2902-4.

Cyclic Calling; 三者通話: Stereotelephony



M. Cohen and L. F. Ludvig, "Multidimensional audio window management,"
Chap. 10 of "Computer-Supported Cooperative Work and Groupware," Saul Greenberg, ed. Academic Press, 1991. ISBN 0-12-299220-2.

Mixer "S & M"



Musical joke

- “Can you play solo?”
ソロはできますか?
- “How do you mean?”
そういう意味ですか?
- “So low we can’t hear you!”
小さくて聞き取れません!

Modal Disabling



Sanbikinolzaru: Kikazaru, Iwazaru, & Mizaru;
三匹の猿: 聞か猿, 言わ猿, 見猿



Distal Deafen; 聞かせざる





Visual Representation of Audio Exclude Functions; 声Exclude機能の視覚表現

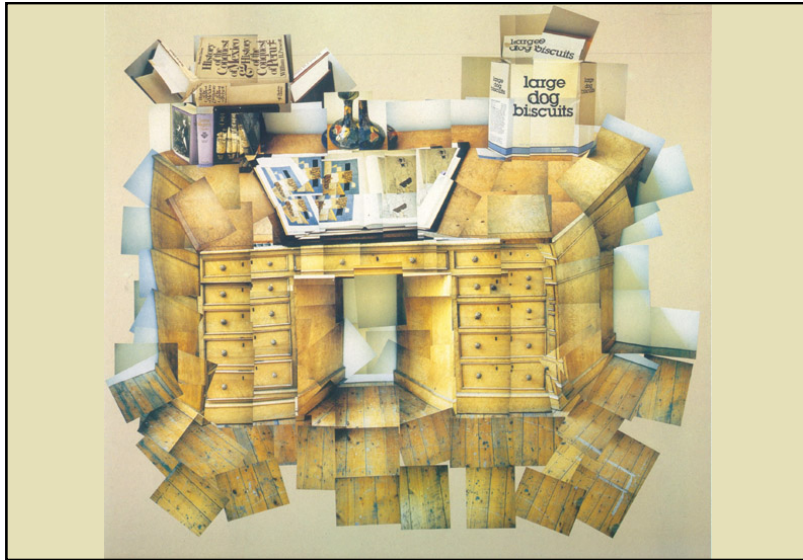
		Source mute	Sink deafen
icon			
figurative representation	own; 自身 (reflexive)		
	others; 他人 (transitive)		

Visual Representation of Audio Include Functions; 音声Include機能の視覚表現

		Source select	Sink attend
icon			
Figurative representation	target (explicit)		
	others (implicit)		

Cubist painting

- Male profile
- Female frontal



Predicate Calculus Notation for Include/Exclude
Narrowcasting and Selection Functions

$$\text{active}(x) = \neg \text{exclude}(x) \wedge ((\exists y (\text{include}(y) \wedge (\text{self}(x) \Leftrightarrow \text{self}(y)))) \Rightarrow \text{include}(x))$$

$$\text{active}(\text{source}_x) = \neg \text{mute}(x) \wedge ((\exists y (\text{select}(y) \wedge (\text{self}(x) \Leftrightarrow \text{self}(y)))) \Rightarrow \text{select}(x))$$

$$\text{active}(\text{sink}_x) = \neg \text{deafen}(x) \wedge ((\exists y (\text{attend}(y) \wedge (\text{self}(x) \Leftrightarrow \text{self}(y)))) \Rightarrow \text{attend}(x))$$


Virtual Concert: Decomposition

concert	コンサート
chorus	コーラス
soprano	ソプラノ
alto	アルト
tenor	テノール
bass	バス
orchestra	オーケストラ
strings	弦楽器
basses	バス
cellos	チェロ
violae	ビオラ
violins	バイオリン
G-string	G-弦
D-string	D-弦
A-string	A-弦
E-string	E-弦
brass	ブラス
horns	ホルン
trumpets	トランペット
trombones	トロンボーン
tuba	チューバ
woodwinds	管楽器
saxophones	サクソフォーン
clarinets	クラリネット
flutes	フルート
oboe	オーボエ
percussion	打楽器
bass drum	バスドラム
cymbals	シンバル
snare drum	スネアドラム
triangle	トライアングル
tubular bells	チャイム
wood block	太鼓
tamtam	タムタム
other	その他
harp	ハープ
piano	ピアノ

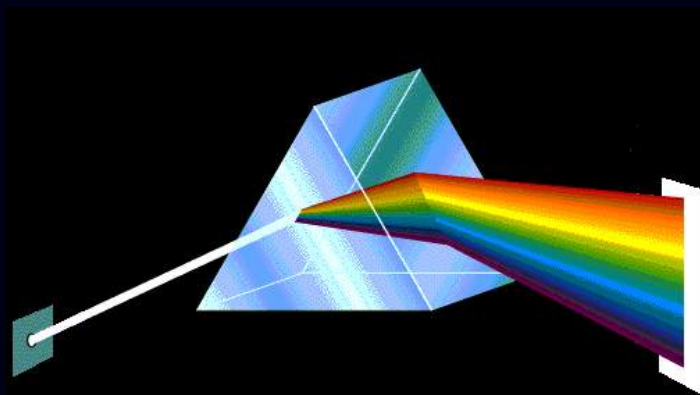
Stereography

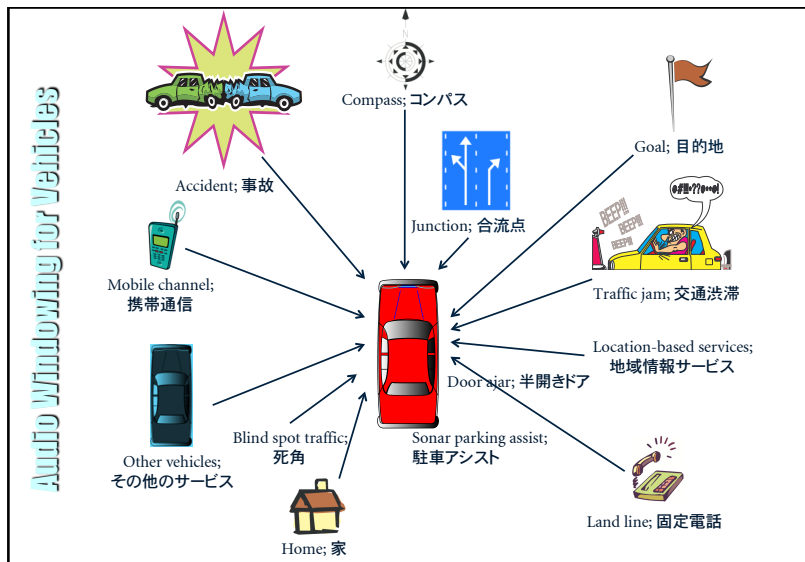
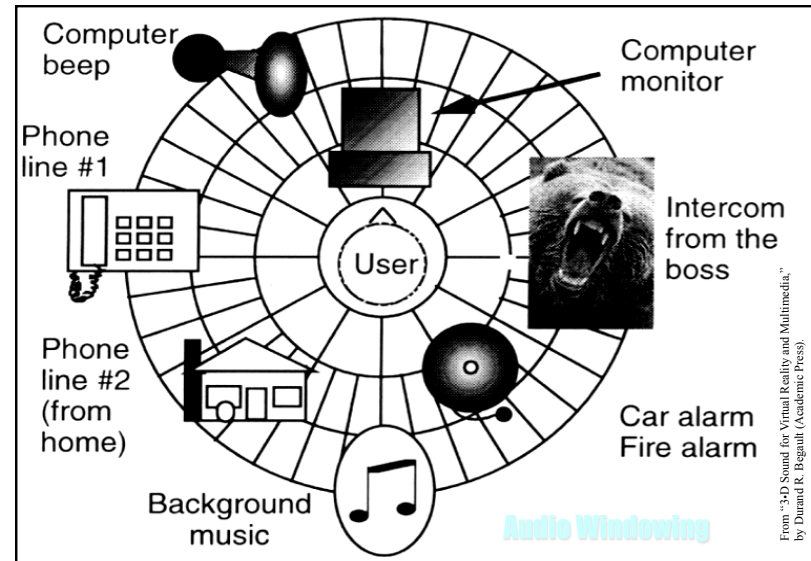
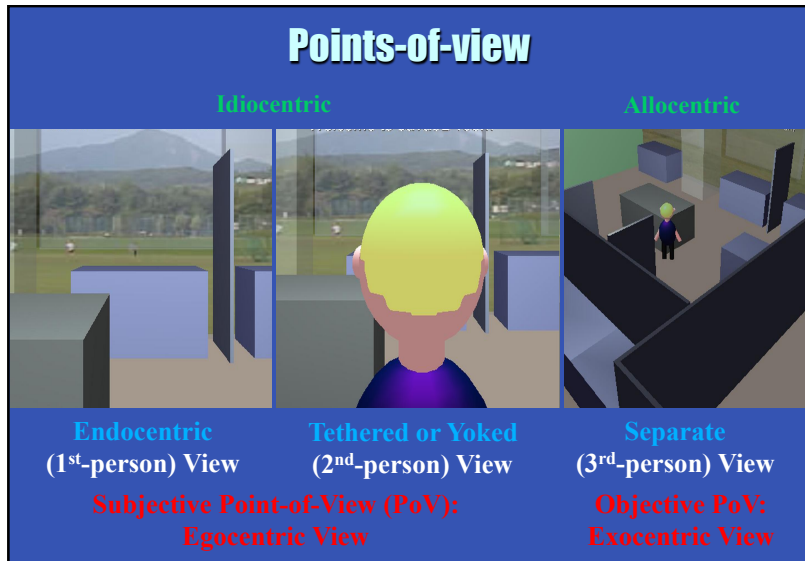
Left and right views are displaced (by interocular distance, 65 mm ≈ 2.5")

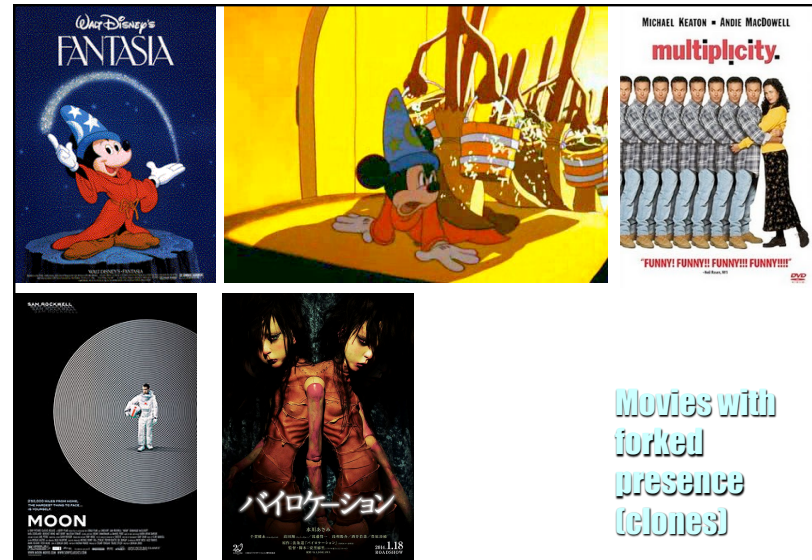
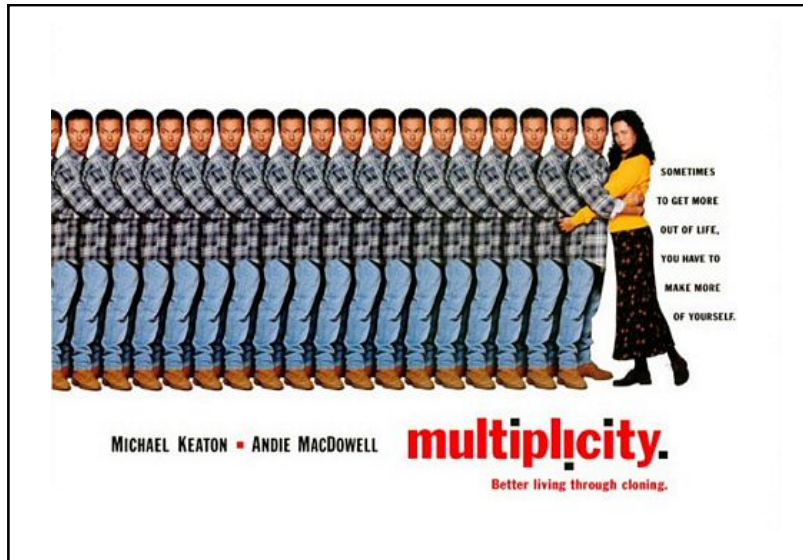


View 01	View 11	View 21	View 31	View 41	View 51	View 61	View 71	View 81	View 91	View 101	View 110	View 120	View 130	View 140	View 150	View 160	View 170																																																																																																																																																														
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Spectral dispersion by prism refraction





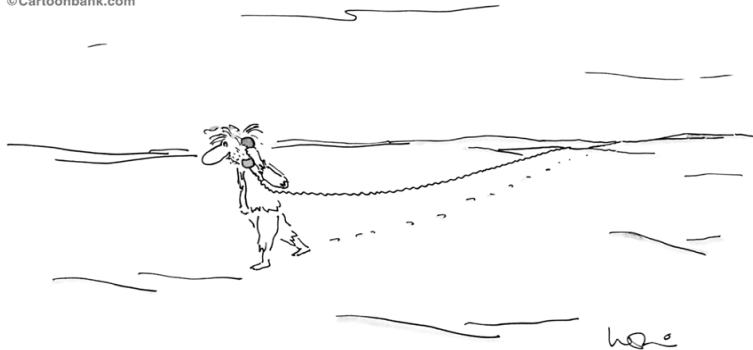


Model	Mode	Network Value	Growth Order	Law
Broadcast (simplex: one-way)	One-many ("fan-out")	n	Linear	Sarnoff (radio and tv executive)
Audience participation: request lines, online voting	Many-one ("fan-in")			
Networked: (duplex: two-way) IM, e-mail, POTS, ...	Many-many	n^2 Transactions: $n(n-1)$ Conversations: $n(n-1)/2$	Power: Polynomial (quadratic)	Metcalfe (networking scientist)
Groupware: social media, discussion groups, auctions, community web sites, chatspaces, CVEs, GSSs - group support sytems, mailing lists, wikis, tweets, blogs, ...	Power set (excepting singletons and \emptyset , empty set)	2^n $(2^n - n - 1)$	Exponential	Reed (groupware scientist)
Networked reconsidered		$n \log n$	Linearithmic	Briscoe, Odlyzko, & Tilly
Synchronous groupware with multipresence		2^*2^n $2^{n \log n} = n^n$	Superexponential or Exponential	Cohen

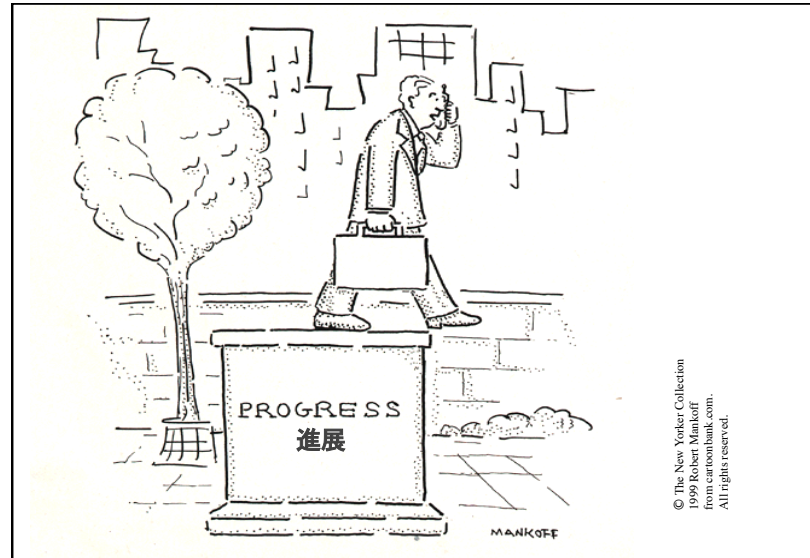
Share & Share Simulator;
インターネット椅子シミュレーション



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Hands-Free Adapter

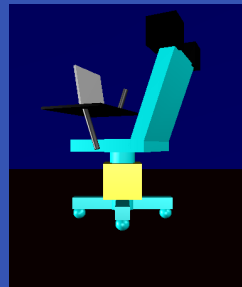
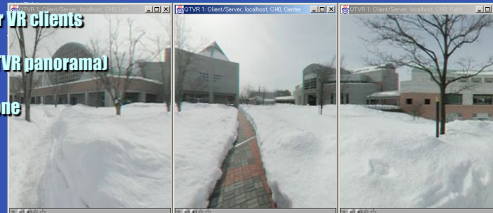


“Poor person’s mobile stereotelephony”



Interface for Mobile Phone:

interoperate with CVE and control other VR clients
 Blurring of real and virtual:
 coupling of image-based rendering (QTVR panoramas)
 and polygon-based CG (Java3D)
 with **par** Internet Chair & mobile phone



Related Conferences & Journals

- AES: Audio Engineering Society
 • www.aes.org
- ICAD: Int. Conf. on Auditory Display
 • www.icad.org
- ICAT: Int. Conf. on Artificial Reality and Telexistence
 • www.ic-at.org
- IEEE Virtual Reality
 • ieeevr.org
- SIGGRAPH
 • www.siggraph.org
- J. of Virtual Reality and Broadcasting
 • www.jvr.org
- Presence: Teleoperators and Virtual Environments (MIT Press)
 • www-mitpress.mit.edu/jrnls-catalog/presence.html
- TVRSJ: Trans. of Virtual Reality Society of Japan
 • www-mitpress.mit.edu/jrnls-catalog/presence.html

ICAT International Conference on Artificial Reality and Telexistence

JOURNAL OF VIRTUAL REALITY AND BROADCASTING

PRESENCE



Professional Societies

- 3D Forum: the Forum for Advancement of Three Dimensional Image Technology and Arts

• www.hi.is.uec.ac.jp/3Dforum

- ACM

• www.acm.org

- IEEE Computer Society

• www.ieee.org

- IEICE

• www.ieice.org

- TeX Users Group

• www.tug.org

- Virtual Reality Society of Japan

• www.vrsj.org

