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●研究室紹介●

会津大学 スペーシャルメディア

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0. Introduction

The University of Aizu was founded nine years ago in 会津若松, 福島県. Aizu-Wakamatsu is about 300 km north of Tokyo (three hours by 新幹線 and 磐越西線), a castle town and gateway to the 東北 region. The Aizu region is proud of its traditional charm and natural beauty — manifested especially through its water-related products and attractions, including tasty rice and 酒, 温泉, 漆, and recreation areas (like those around 磐梯山 to the north and 猪苗代湖 to the east). Local cultural destinations include 飯盛山, site of the 白虎隊 Incident.

The University has about one hundred faculty and fifty staff members serving about one thousand undergraduates and almost two hundred graduate students. Virtual reality research at the University is conducted mainly through groups led by the authors, the "Spatial Media Group" and the "Cyberspatial Audio Group." The first author (Cohen) is primarily interested in hypermedia interfaces [8], while the second author (Martens) focuses on psychoacoustics and virtual acoustic rendering technology [17] [16]. Jointly we currently supervise the themas and theses of about ten seniors and ten graduate students. Naturally there is significant overlap [2] [10] [9] [12], but this review will concentrate on the multimedia aspects and a subsequent article will elaborate on our cyberspatial audio research.

1. Curriculum

Pertinent offerings include a semester-long dspcourse for advanced undergraduates and year-long undergraduate projects in Computer Music and VR Sound, as well as quarter-long graduate courses in Visual Communication, Computer Music, and Acoustic Modeling [11]. These courses are barely sufficient, and we plan to expand the syllabus, pending local and Monbusho approval. In addition to the normal curriculum, the authors organize three other annual educational programs:

Creative Factory Seminar The University Student Affairs Office sponsors intensive hands-on seminars, providing students practical exposure to special ideas and technologies outside the usual curriculum. Last year's Spatial Media seminar, taught by 小林広美 of SensAble,[1] highlighted the {neurons, bits, atoms} triad (elaborated by 石井裕 of the MIT Media Lab). Participants' artistic ideas were reified by a PHANToM-equipped FreeForm force-feedback CAD system and then 3D-printed ("rapid-prototyped") by 豊田通商.

This year's Spatial Media exercise, which will be led by Hans Shimizu-Karlson, will coach participants through the capture, stitching, and browsing of panoramic photographic scenes and object movies, using (Nikon CoolPix 990) digital cameras with 8mm fisheye lens and panoramic tripod heads,[2] Cubic QTVR,[3] and authoring and stitching software (QuickTime VR Authoring Studio, DeFish,[4] Panorama Tools[5], soundsaVR[6], and VRWorx[7]).

公開講座講演　The University Community Affairs Committee sponsors a public lecture series[8] at which students and faculty introduce ongoing research to the lay community. This year's Spatial Media Group presentation[9] is especially for preteenagers, giving our group members an opportunity to describe and demonstrate their research accessibly to young people.

International Conferences The University's International Affairs Committee sponsors academic conferences, welcoming international researchers for themed symposia. This year's 2nd International Workshop on Spatial Media[10], devoted to

"Augmenting Human Spatial Communication through Spatial Audio," will be held Oct. 25 - 26; interested readers of JVRSJ are naturally welcome to participate. Another international conference, the 8th Int. Workshop on Human Interface Technology, is being planned for later in the academic year.

2. Facilities

We have several lab areas devoted to virtual reality research projects, including an anechoic chamber, computer music studio, and experimental rooms. Regarding operating systems, we are necessarily promiscuous, using various platforms and OSs. All University of Aizu graduate students are assigned their own (SGI or Sparc) workstation, and we also leverage the University's clusters. We maintain PCs (running both Linux and Windows flavors), legacy equipment (including NeXT cubes!), and Apple Mac-intoshes, whose recently released OS X is admired for its elegant user interface wrapped around a Unix-like kernel.

2. 1 Cyberspatial Audio Experimental Space

We have an anechoic chamber, used for recording dry signals, measuring transfer functions, and conducting subjective listening tests. We use the B+KHATS (**h**ead **a**nd **t**orso **s**imulator) [4], a binaural microphone system for measurement and recording.

2. 2 Computer Music Studio

Undergraduate and graduate computer musicclasses cover music theory [21], computer music basics [20], composition, and performance, emphasizing both "book knowledge" and hands-on experience. Our computer music studio includes MIDI drumkit, guitar, and wind controllers; a Casio LK-65 with "光ナビゲーション," a Yamaha Clarinova P-500 electric piano and Korg X3 music workstation; cassette, CD and CD-ROM, DAT, mini-disc, and hard disk player/recorders; a patch bay; various rhythm and sound modules, tone generators, and samplers;and about ten Macs and five PCs, each equipped with a MIDI keyboard controller/synthesizer. A typical student station comprises an iMac with USB-connected Roland XP-10 keyboard synthesizer and stereo earphones. We use the Band-in-a-Box[11] composition/arrangement/performance software because of its accessibility to non-specialists as well as its rich feature set. A central 24-track mixer allows selective audition during group sessions.

2. 3 マルチメディア センタ

We do research in the Multimedia Center[12] at the University of Aizu, especially those associated with the Synthetic World Zone (3D/ 立体映像 シアター),[13] which spatially immersive display features a large stereographic screen and the PSFC (Pioneer Sound Field Controller[14]) [1], a hemispherical loudspeaker array driven by a unique DSP capable of spatializing two dynamic mixels. After the summer's うつくしま未来博 Exhibition,[15] the spatial audio system will be extended by eight linked Roland RSS-10 DSPs using the "Staff" networking software.

3. Research Projects: Heterogeneous Multimodal Groupware

Over the last several years, our students have created heterogeneous interfaces, all implemented in Java (with Java3D, JMF, and Swing), including: a 2.5D dynamic map [19] (shown in top left of 図 1) allowing not only planar translation but also rotation; a spiral spring GUI (top right of 図 1) [3]; Helical Keyboard [14] (bottom left of 図 1), originally prototyped in Mathematica[16][7]; a panoramic browser (bottom right of 図 1); and a PSFC proxy. We enjoy experimenting with stereopsis[17][18]: the panoramic browser includes a stereographic mode, and the Spiral Spring and Helical Keyboard interfaces feature chromastereoptic displays[18].

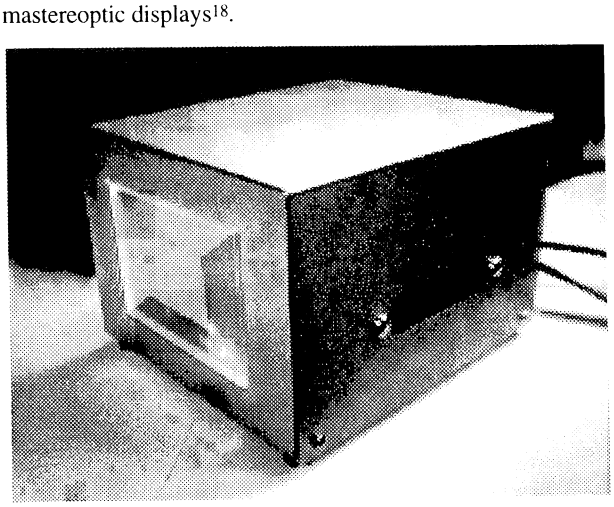

図 3 Paco the Magic はこ: programmed scenarios projected on the LCD screen respond to motion captured by an embedded 6-DOF gyro sensor. Invented by Scheme of Entertainment.

This year, we are working on interfaces for a driving simulator; an (Applied AI Systems[19]) telerobot[20][13] (shown in 図

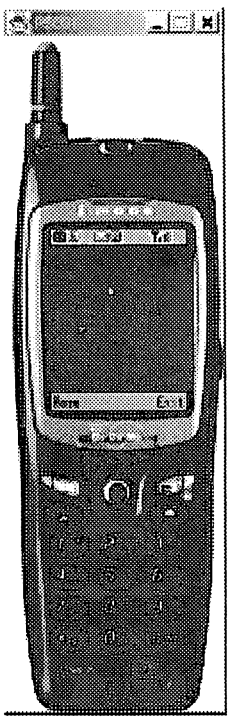

図4 携帯 電話 会議: the jog wheel is used as a continuous controller to translate and rotate icons in a teleconference. The user interface is extended with musical and vibration cues. J2ME iAppli programming by 長島豊.

5); teleconferencing via mobile phone (shown in 図4), networked with a "servent" (**serv**er/cli**ent** hybrid) gateway being developed with Jakarta Tomcat[21] by strategic partner あいづ・ジャパン[22]; the "Paco Magic はこ"[23] (shown in 図3); and the Internet Chair [15] (shown in 図2), being developed in conjunction with 山形大学 and メカテック, [24] an industrial partner based in 喜多方.

Using a client/server architecture and framework designed by 菅野才文, we are integrating these disparate interfaces into a unified suite. Our system is multiuser (supporting multiple simultaneous users in realtime interactivity), multimedia (driving graphical, auditory [stereo, transaural, and speaker-array spatial audio], musical, and video displays), multimodal (providing visual [WIMP/GUI plus perspective representation], auditory, haptic and force-feedback interaction), and multiperspective (including orthographic [2.5D map], stereographic panoramic [QTVR], and perspective [Java3D] visual displays).

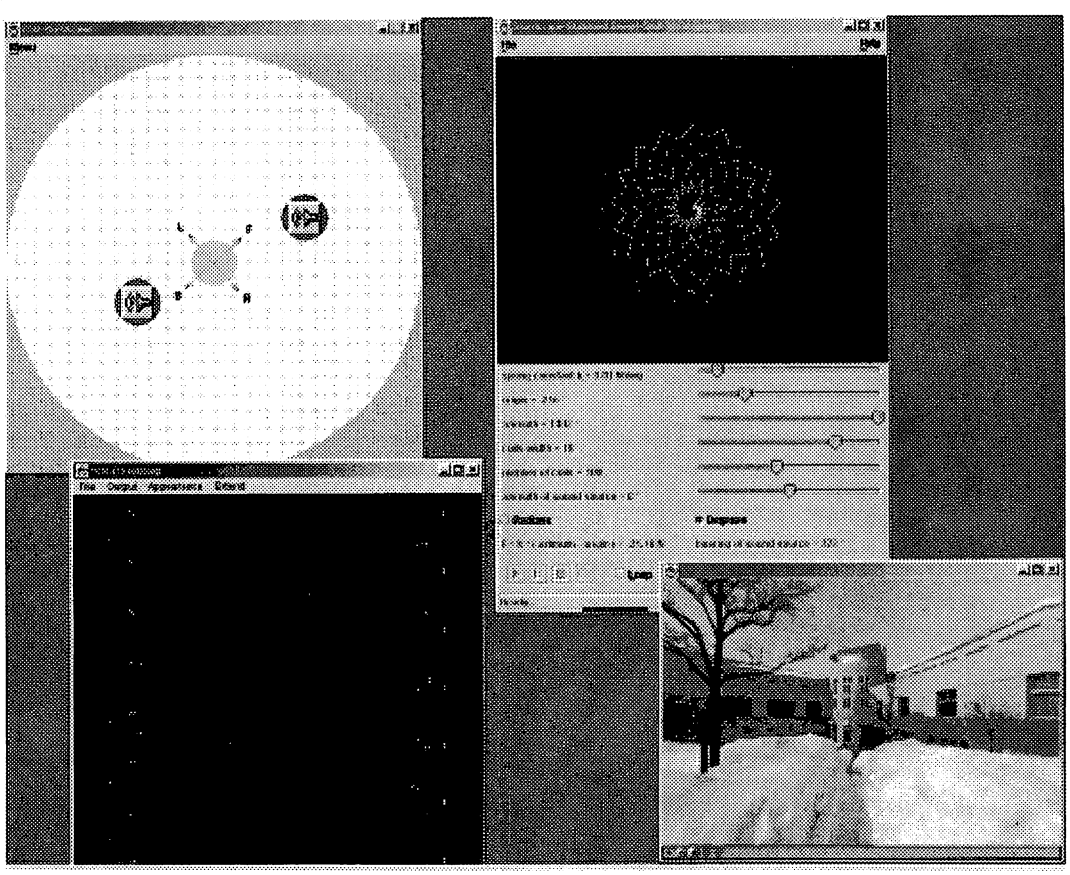

図1 Multiclient session snapshot of one user's display of collaborative distributed virtual environment, including (counter-clockwise from top right): soundscape-stabilized spiral-spring (swivel-seat), by 佐々健太 and 伊原正悟 with 和田貴志, which can directionalize (lateralize) a mixel in near-realtime from a resident file or captured audio stream; 2.5D dynamic map, by 清水雅高, in which icons can translate and rotate; Helical Keyboard, by 菅野才文, to visualize the helical structure of musical scale, animated in realtime by GUI or MIDI events; QT_4 U_2C browser, by Noor Alamshah Bolhassan, for multiwindow/display and/or stereographic panoramic display. All of these clients interoperate as groupware, synchronizable locally or over the internet.

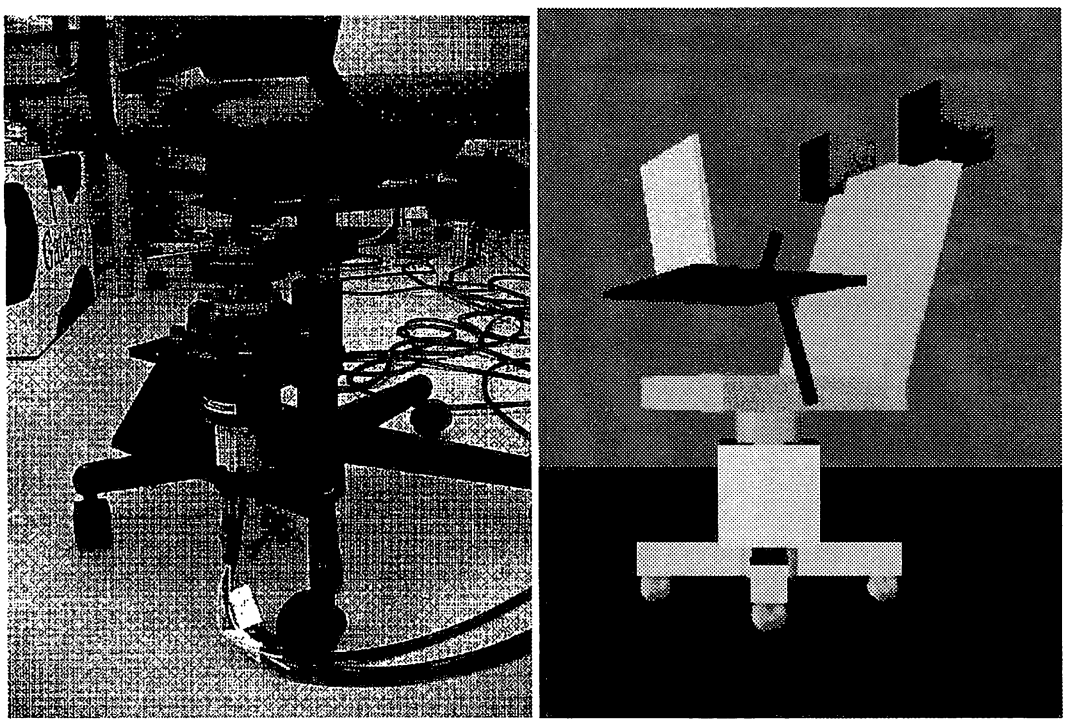

図2 Internet Chair with servomotor rotation: a pivot (swivel, rotating) chair deployed as an I/O device, an information appliance. The input modality is orientation tracking, which can dynamically select transfer functions used to spatialize audio in a rotation-invariant soundscape. In groupware situations, like teleconferencing or chat spaces, such orientation tracking can also be used to twist iconic representations of a seated user, avatars in a virtual world, enabling social situation awareness via coupled visual displays, soundscape-stabilized virtual source locations, and direction-dependent projection of non-omnidirectional sources. As an audio output modality, transaural speakers (without crosstalk), "nearphones" in the headrest, can present unencumbered binaural sound with soundscape stabilization for multichannel sound image localization. As a haptic output modality, servomotors can render force-feedback (kinesthetic), turning themselves under networked control, to direct the attention of a seated subject (with adjustable insistence/forcefulness), orienting seated users (like a "dark ride" amusement park attraction), or subtly nudging them in a particular direction. Developed by in conjunction with researchers led by 渡部慶二 and 羅志偉 at 山形大学 in 米沢. Java3D model by 金子大輔.

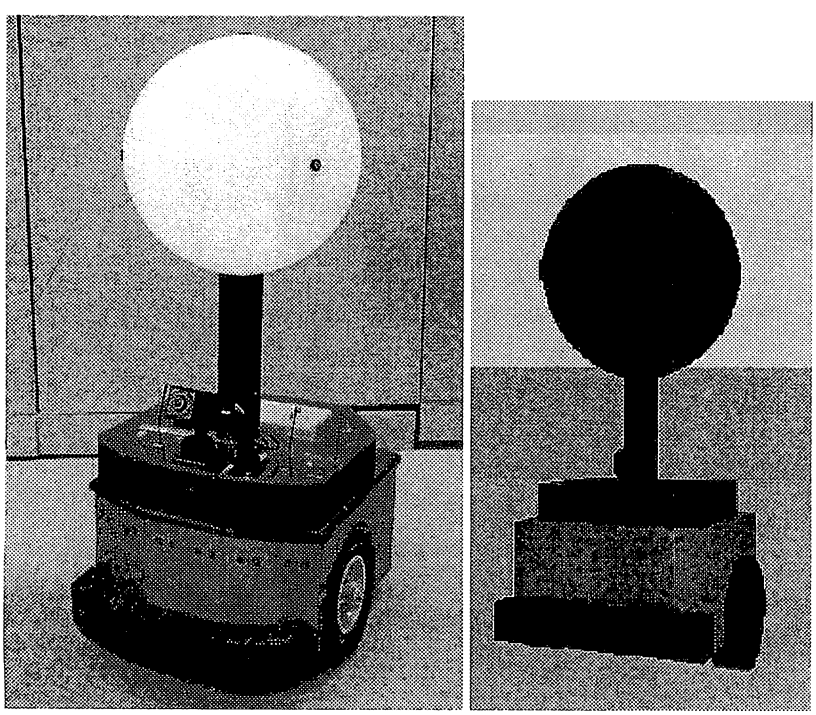

図5 "Hero" Labo-3 mobile hearing telerobot: operable in piloted and autonomous (automatic obstacle avoidance) modes, with cyclopean (one-eyed) camera and quadraphonic tetrahedral microphone array. Deployed in lab of 黄捷, and programmed by 山崎泰宏. Java3D model by 収納和樹. Streaming media functionality programmed by 柳智英.

図6 "Poor person's mobile stereotelephony:"two mobile phones deployed as a microphone array attached to a dummy head simultaneously calling a dual voice line (like that provided by ISDN) realizes wireless (if still low-fidelity) binaural telepresence.

4. Future Projects

We anticipate leveraging these systems against emerging internet standards XML and MPEG-4[25] (for object-oriented multimedia, including audio streaming and spatialization). We are especially interested in broadband mixed reality/virtuality systems (also known as, or related to, annotated, augmented, enhanced, hybrid, mediated, or virtualized reality systems), which blur sampled and synthesized data, especially realtime media streams.

An information or media sink is the dual of a source. We are working to deploy extended attention management and privacy/security protocols for multisink situations based upon the idea of multipresence: selective ubiquity (having presence in more than one space simultaneously), as represented by multiply instantiated avatars. We are developing an articulated permission system [5] [6], which sink capability is representable in predicate calculus notation as: active($sink_x$) = ¬ ignore($sink_x$) Λ (∃ y attend($sink_y$) ⇒ attend($sink_x$))

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