

3.2.2 CORRELATION PROCESSING SOFTWARE

By

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ABSTRACT

The Key Stone Project (KSP) aims to provide daily crustal deformation monitoring data around the metropolitan area. One of its key technologies is VLBI. Radio signals observed by four stations are recorded on magnetic tapes and sent to a correlation and data analysis center in Koganei. The tapes are played back synchronously and 4×256 Mbps data is fed to six baseline KSP correlators. The huge amount of data is processed and radio propagation delays among four stations are extracted and stored in a Mark-III database. Software KATS was developed to provide an operator with a unified graphical user interface (GUI) for operations. It was designed to enable non-expert operators to perform this correlation data processing simply by mouse clicks and a few key strokes. This paper describes the VLBI cross correlation system in the KSP and functions of the correlation control software KATS.

Keywords: VLBI, GUI, Cross correlation, Bandwidth synthesis, Mark-III database

1. Introduction

The KSP VLBI system consists of four VLBI stations in Japan each with 11m diameter antenna located in Koganei, Kashima, Miura, and Tateyama. Two types of VLBI system are used in the KSP. In one, radio signals observed from radio stars are recorded on magnetic tape. Here we call this type a "tape-based" VLBI. The other type of system uses an optical fiber network to transport observed data from all four stations to a correlation center. Correlation processing is done during the observation. This system is called a "real-time" VLBI⁽²⁾⁽⁸⁾. In this paper, we describe correlation processing software for the "tape-based" VLBI system.

Radio signals from radio stars are observed and recorded on magnetotapes at four VLBI stations. After the experiment, magnetic tapes are sent to Koganei VLBI correlation and data analysis center. The huge amount of data (about 50Tbit : 256 Mbps \times 24 hours of experiment \times 4 stations) is processed and the stations' positions are extracted with an accuracy of a few millimetre.

An ordinary geodetic VLBI experiment (hereafter just called experiment) consists of several hundreds observations. Cross correlation is performed from one observation to the other. In the next step, bandwidth-synthesis processing (KOMB) is applied. After all the observations are processed, the group delays are extracted from the KOMB output file and stored in a Mark-III database system, which is widely used in the global geodetic VLBI community.

This data reduction procedure, from synchronized play back of four stations' magnetic tapes up to storing the data in the Mark-III database, is complex and requires many commands to be sent to computers and correlators. It also requires skill and knowledge about VLBI equipment and computers on the part of the operator. The KATS was developed for the KSP VLBI to make this procedure semi-automatic and to help an operator by providing a graphical user interface (GUI).

The CRL was a pioneer of VLBI technology in Japan

and K3 system was the first Japanese VLBI system developed by the CRL for Japan-US geodetic VLBI experiments. It has compatibility with Mark-III(A) VLBI system developed by the U.S.A. and is capable of 2 baselines with maximum data processing rate of 128Mbps. The data reduction procedure was operated in step by step by typing command to computer display. The know-how of the K3 correlation system has been introduced in the KATS. The KATS runs on HP-UX operation system. The maximum number of baselines/stations which the KATS can deal with is ten baselines/five stations. The maximum data processing rate is 256Mbps per one baseline. The role of the KATS can be summarised as (1) collecting information for data processing, (2) commanding the execution of correlation process to Correlator Controller, (3) receiving the correlation output data and applying bandwidth synthesis process to the data, (4) storing the data in Mark-III database system, (5) managing the flow of these procedure. The KATS does not calculate the delays and delay rates of correlator model, but providing the information for that to each correlator. The correlator model calculations are done by each correlator in the baseline base.

The next section describes the hardware and software component of the correlation system. Section 3. explains the principle of operation, and describes the specifications of KATS, input files, and internal files. Section 4. describes several remarkable features of KATS.

2. System Components

2.1 Hardware components

Fig. 1 illustrates the KSP VLBI tape-based correlation system with their hardware components, which is located at the Koganei correlation and data analysis center. Details of each piece of equipment are given in paper 3.2.1 "Correlation Processing System"⁽¹⁾. Here we review them briefly.

Correlation Process Control Computer (CPCC): KATS runs on a CPCC (HP9000/735) HP-UX workstation. The CPCC is connected with a correlator controller

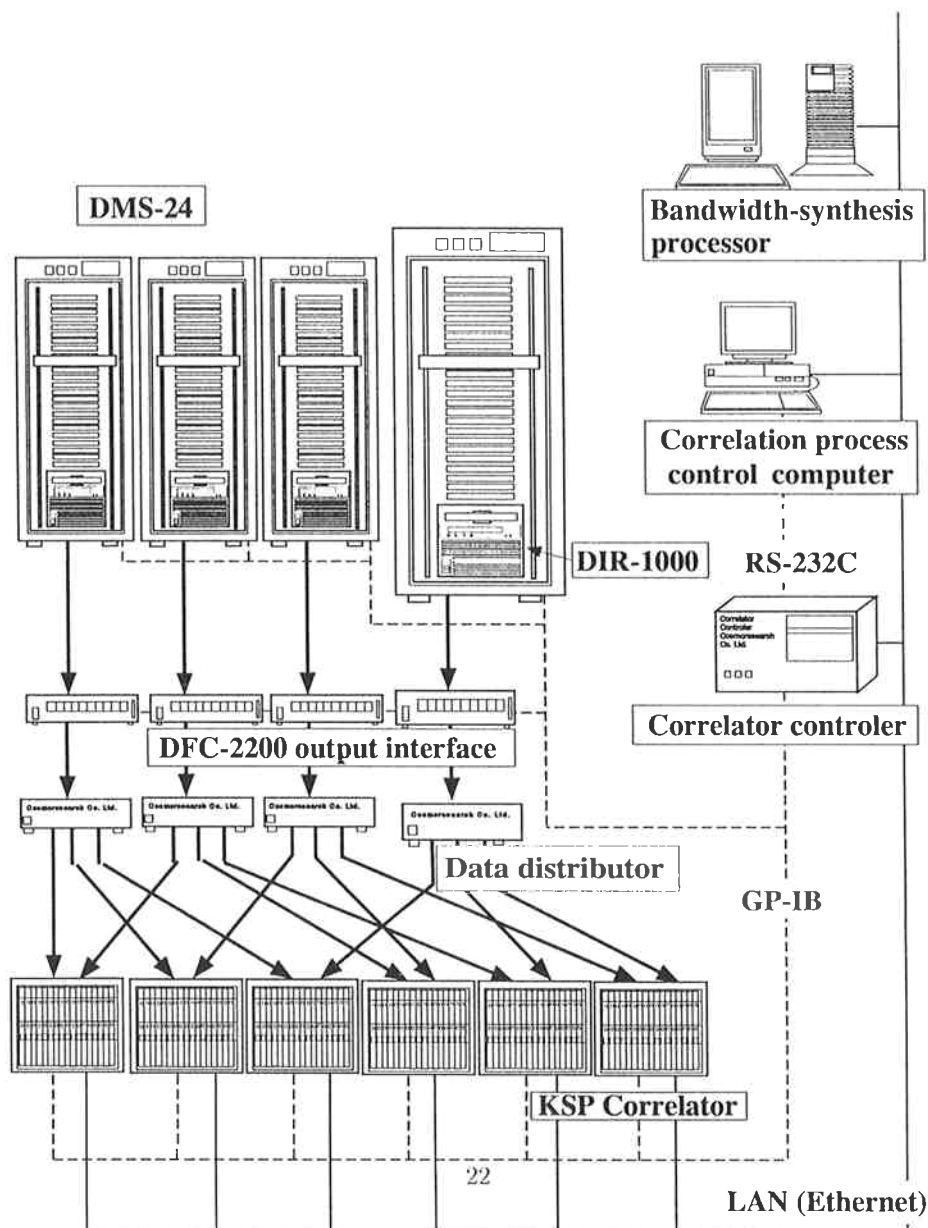


Fig. 1 KSP VLBI tape-based correlation system

(CC) via an RS-232C cable and is also connected to a local area network (LAN) using Ethernet. The CPCC acts as PC network file system (PC-NFS) server and receives output data from the correlators via the LAN.

Correlator Controller (CC): The CC has an MC68040 CPU and controls all the hardware for correlation through GP-IB. It communicates the status and commands with CPCC via the RS-232C.

DIR-1000 and DMS-24: Data recorder/player DIR-1000 provide 256-Mbps high speed recording and play-back. It is placed inside a DMS-24 K-4 cassette tape auto-changer, which can hold 24 K-4 tapes, corresponding to 36 hours of 256-Mbps VLBI observation data. The

DMS-24 is controlled by the CC via GP-IB bus and it changes K-4 tapes on the DIR-1000 automatically. This enables automated 24 hours of VLBI observation and unmanned correlation processing.

Output Interface DFC-2200: The DFC-2200 interfaces between data recorder/player (DIR-1000) and correlator. Four DFC-2200s are controlled by the CC and synchronously play back data of four stations.

Correlator: Six single baseline correlators are used in this system. Each correlator receives a synchronised pair of data streams from two DFC-2200s through distributors and performs six baselines correlation processing operation in parallel. The correlators work as clients of the PC-NFS and write correlation data onto

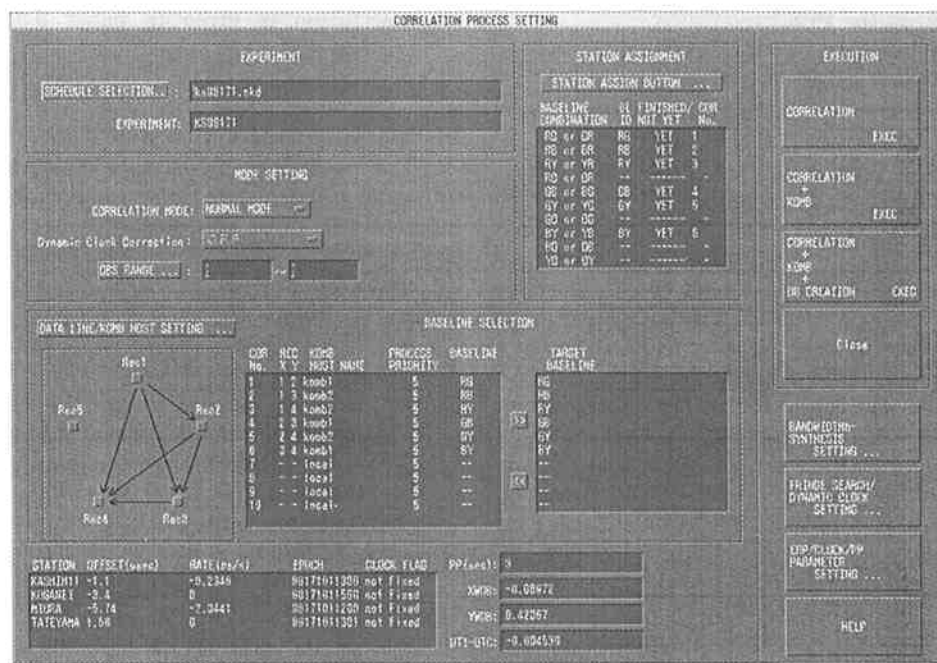


Fig. 2 Example of correlation setting GUI in computer display. Japanese characters in display has been translated into English in this paper.

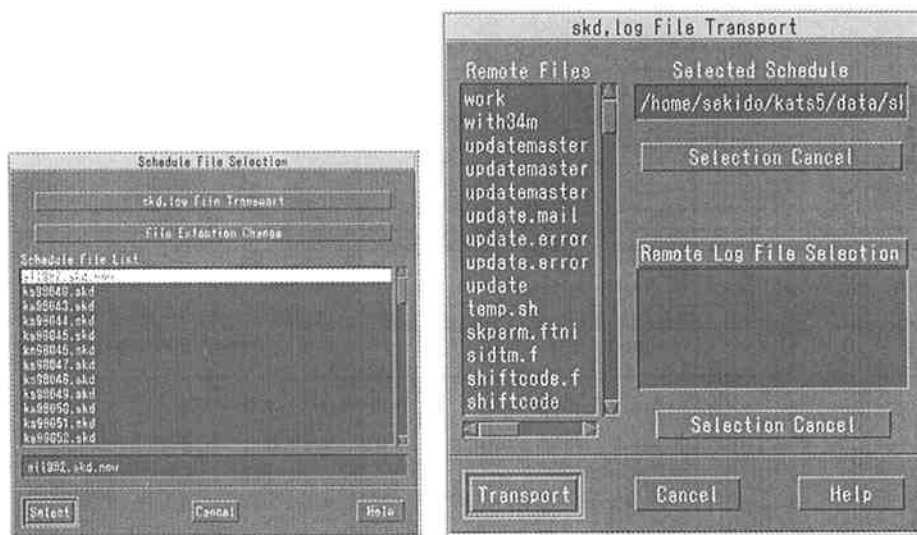


Fig. 3 Example of schedule file selection window (left) and file transport operation window (right). Japanese characters in the windows are translated into English.

the CPCC's hard disk directly via the LAN.

Bandwidth-Synthesis Processor (BWSP): The bandwidth-synthesis processing software (KOMB) runs on two HP9000/J210 workstations. The hard disks of the BWSP and CPCC is mutually mounted on each other by network file system (NFS). Therefore correlation output data can be seen from both computers, the heavy computation load of KOMB is shared, and the data is processed by multiple workstations in parallel.

2.2 Software components

Correlator Controller Software (CCS): The correlator control software (CCS) runs on the CC and controls the DMS-24s, DFC-2200s, and correlators. It receives the initialisation and correlation start signals from KATS via the RS-232C and gets other information from KATS internal files (see section 3.2.3) via the PC-NFS. The CCS performs correlation processing by using the information in those files. It manages one observation correlation processing operation using all of the hardware components. After one run has finished, a command to process the next observation is

sent from KATS to the CCS.

KAnameishi data processing Togo Software (KATS):

KATS provides a GUI for easy operation of VLBI data reduction. It manages data reduction on a whole experiment, which contains several hundred observations. The working flow is as follows.

KATS gets the schedule file and log files from the central observation control computer⁽⁶⁾ by FTP (File Transport Protocol). Then it reads those files, extract information for correlation processing and saves it in internal files (see section 3.2.3). The operator modifies the process settings via the GUI and starts the correlation process. KATS sends a start signal to the CCS via the RS-232C for every observation. Information necessary for correlation processing is passed to the CCS by the PC-NFS. When one observation correlation processing operation has finished, KATS invokes KOMB for the correlation output files on a local or remote computer. After KOMB has finished for all the observations in the experiment, KATS launches the Mark-III database creation software (db.pl). Then the observed propagation delay information is stored in the database.

Bandwidth-Synthesis Software (KOMB): KOMB is software for synthesizing 16 channels of correlation output data to extract the propagation delay very accurately. The functions are described in paper 3.2.3 "Bandwidth Synthesizing Software"⁽⁶⁾ in detail. Correlation output data is shared by workstations connected to the LAN, then KOMB is invoked on multiple workstations for multiple baseline processing.

Mark-III Database Creation Software (db.pl): After KOMB processing has finished for all observation data, KATS prepares a set of information for storage of the data in a Mark-III database. It invokes db.pl, which create a new entry of Mark-III data base for the VLBI experiment. After that, automatic baseline analysis software (VLBEST) is launched and the baseline lengths and station positions are derived within an accuracy of a few millimetre. A detailed

description is given in paper 3.3.1 "Data Analysis Software"⁽⁶⁾.

3. KATS Specifications

3.1 Operation instruction and flow

The basic flow of instructions is explained below. By following these instructions, an operator, who is not an expert about VLBI, can perform correlation processing for pairs among four stations i.e. six baselines.

Getting Started

First of all, the operator must select [Setting] → [Preparation] menu from the KATS main window. Then the "Process Setting" window (see Fig. 2) will pop up. Clicking the button "SCHEDULE SELECTION" causes the schedule selection window (Fig. 3) to pop up offering available VLBI schedules on the local disk (/usr/local/kats/data/skd). If non of them are suitable, the operator clicks "skd, log File Transport", and a file transport window (see Fig. 3) pops up. Here he can get a schedule file and log files from the remote host computer (central observation control computer: see paper 3.1.4 "Observation and System Management Software"⁽⁶⁾) by FTP. KATS reads the schedule file, extract observation information, and stores it in internal files (see section 3.2.3).

Assignment of Stations to Cassette Tape Players

The operator mounts K-4 cassette tapes for correlation processing in the DMS-24s. Details of which station's cassette tapes were mounted on which DMS-24 should be reported to KATS. This is done in the station assignment window (Fig. 4 right), which pops up from the "Station Assignment" button" (Fig. 4 left). The operator assigns station names and log files to each recorder number and finally clicks "OK". Then KATS reads the log file and extracts /ST/, /TD/, and /LABEL/ data and stores them in KATS internal files (see section 3.2.2).

Process Mode Setting

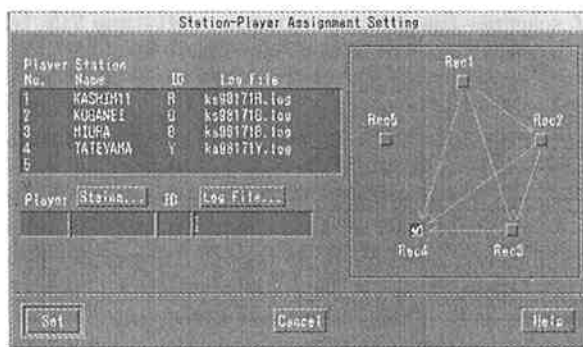
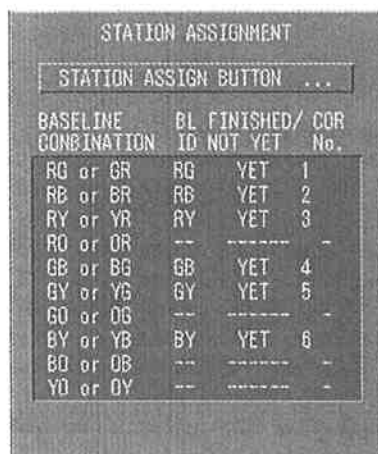


Fig. 4 Example of Station assignment window. Japanese characters in the window are translated into English.

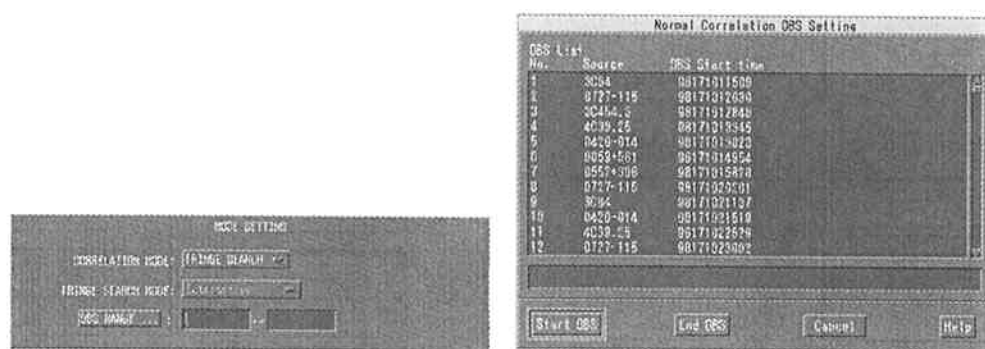


Fig. 5 Observation range setting windows. Columns to set range of observation numbers (left) and observation number selection window (right). Japanese characters in the windows are translated into English.

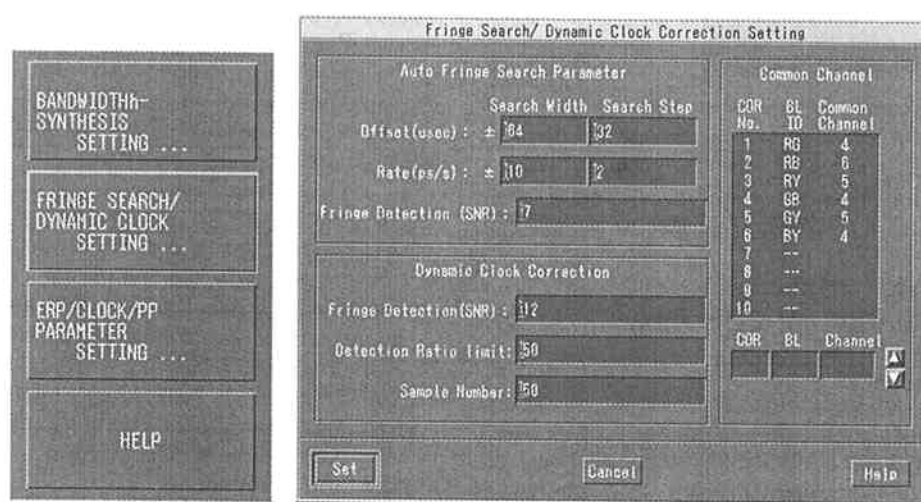


Fig. 6 Fringe search setting button (left) and common channel setting window (right). Japanese characters in the windows are translated into English.

The operator has a choice of two correlation modes: "normal" or "clock search". In the "normal" mode, 16 frequency channels of data are processed normally. In the "clock search" mode, data of one frequency channel (common channel: see "Common Channel Setting") is distributed among 16 correlation units with a different time delay applied to each unit. The source to be processed is chosen from "Fringe search source list", which is written in the term of \$SOURCE in SRCH_INF file. This mode is used for the clock parameter search procedure and the data is not processed by KOMB.

Setting Observation Number

An ordinary geodetic VLBI experiment consists of several hundreds observations, each lasting several minutes. Sequential numbers are assigned to the observations, and the operator can set the range of numbers to be processed in a column in the window (see Fig. 5 left) from the keyboard. Another way to input the observation number is to click the "OBS" button in the window. Then a list of

observation number, radio source name, and observation start time will pop up (see Fig. 5). The operator can select the observation number there.

Common Channel Setting

The common channel is the channel whose data is distributed to 16 correlation units for fringe search processing. This common channel is necessary even for "normal" correlation mode. Clicking the "FRINGE SEARCH/DYNAMIC CLOCK SETTING..." button (Fig. 6 left) causes "Fringe Search Setting" window (Fig. 6 right) to pop up. The operator sets the common channel for each baseline using up-down arrows.

Process Execution

After setting up the processing, the next step is execution. There are three choices of procedures (see Fig. 7). In the first mode, only correlation processing is done. The second mode is correlation processing and KOMB processing. The third is from correlation processing to database creation, which is the mode usually used in the routine VLBI reduction procedure.

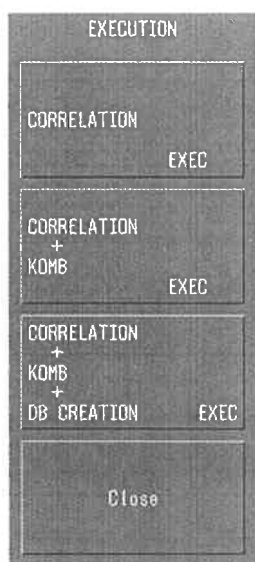


Fig. 7 Execution selection buttons.

These steps are basic operations for routine work. Additional settings listed below are not necessary for daily routine operation, but some of them are necessary when the first time KATS is run.

Data Line/KOMB Host setting

KATS has to know the actual data line connections from data recorders to correlators. This should be registered in KATS when KATS runs for the first time after installation. Clicking the corresponding button (Fig. 8 left) causes the "Data Line Connection/KOMB Host Setting" window (Fig. 8 right) to pop up. The operator sets data line connection information using the mouse. Also the names of host workstations, on which KOMB process is done, can be set here. The priority of the process ("nice" value in UNIX c-shell) should be in the range from 0 (highest priority) to 39 (lowest priority).

Baseline Selection

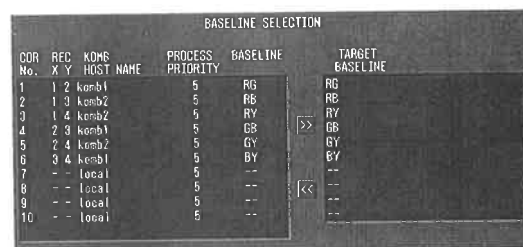


Fig. 9 Baseline selection window.

The sets of baselines are selectable in the "Baseline Selection" window (see Fig. 9). All the baselines are selected in default. The selection function is for cases where a certain baseline is not wanted.

Bandwidth-Synthesis Setting

Frequency band parameter, S, X, or S/X, has to be specified in bandwidth-synthesis process. The parameter can be set in the window popped up from the KOMB setting button (Fig. 6 left).

ERP/Clock Parameter Setting

The clock parameter, and Earth Rotation Parameter (ERP) are automatically set from observation log files and the ERP file. The ERP information is obtained from the International Earth Rotation Service (IERS). If the operator needs to modify these values, he can do so in the "ERP/Clock/PP Parameter Setting" window popped up from "ERP/Clock/PP Parameter" button (Fig. 10). The parameter period as correlation integration time is also adjustable in this window.

3.2 Files and directories

3.2.1 Directory tree

KATS runs in the directory environment shown in Fig. 11. The "bin/" directory contains executable files. The "data/" directory consists of schedule file directory: "skd/", log file directory: "log/", internal file directory: "data/", process history file directory: "prc/", and temporary file directory: "temp/". The rolls of each kind of

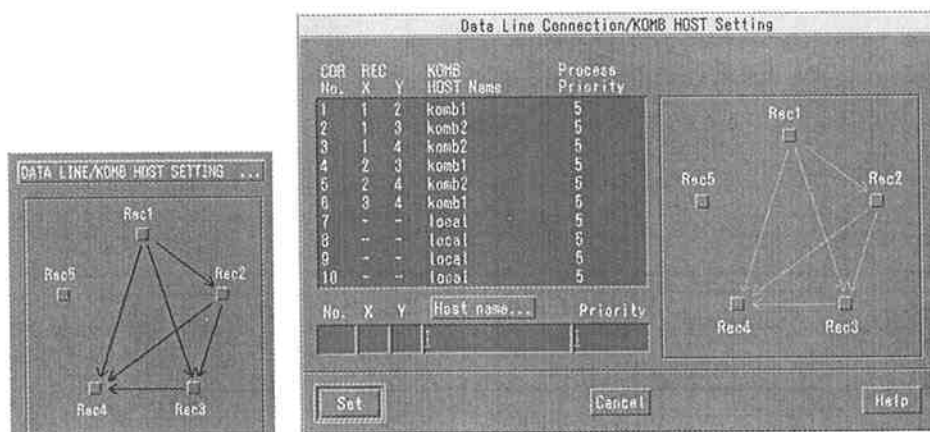


Fig. 8 Data Line Connection/KOMB HOST Setting window.

ERP/CLOCK/PP Parameter Setting

PP (sec) : 3

Earth Rotation Parameter: XWOB: -0.08972 YWOB: 0.42367 UTI-UTC: -0.094539

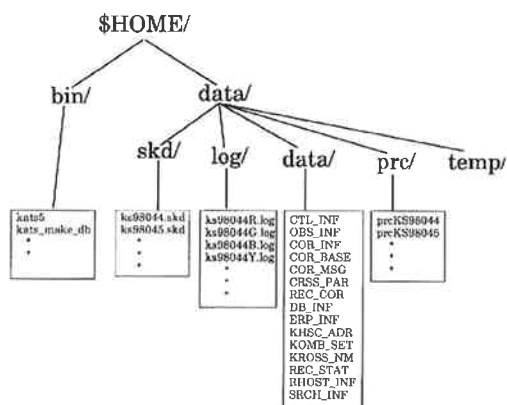
REC No.	Station name	Clock Offset (usec) Original Correction	Clock Rate(pp/s) Original Correction	Epoch	Clock Fix Flag
1	KASHIMI	-1.1 0	-0.2348 0	98171011300	Floating
2	KOGANEI	-3.4 0	0 0	98171011500	Floating
3	MITURA	-5.74 0	-2.3441 0	98171011200	Floating
4	TATEYAMA	1.56 0	0 0	98171011301	Floating
5					

No. 観測局名 Original Correction OriginalCorrection Epoch Clock Flag

Corrected Clock Offset(usec) Corrected Clock Rate (pp/s)

Set Cancel Help

Fig. 10 Example of ERP/CLOCK/PP Parameter Setting window. Japanese characters in the windows are translated into English.



```

dddhhmmss/LABEL/KSR1201A
dddhhmmss/TD/ 1.0
dddhhmmss/WX/ 27.4, 1002.3, 84.3
dddhhmmss/CABLE/0.1
dddhhmmss/ST/12345
  
```

Fig. 13 Example of log file. ddd: day of the year, hh: hour, mm: minutes, ss: seconds in UT.

Fig. 11 KATS home directory structure.

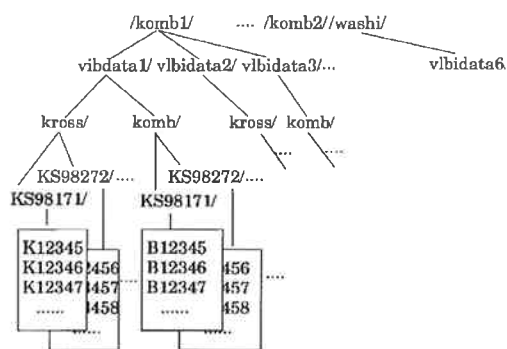


Fig. 12 Output data directory structure.

file are described in the next section.

Output data from a correlator and KOMB is written in the directory structure shown in Fig. 12. An example of directory path name is "/komb1/vlbidata3/kross/KS98171/". The top directory name is host-name where the hard disk is locally mounted. The second directory name shows the directory is used for VLBI data storage.

The third name indicates whether the data is correlation output data (kross) or KOMB output data (komb). The fourth name is the experiment code name.

HP9000/J210 workstations "komb1" and "komb2" and HP9000/735 and HP9000/745 workstation "washi" and "eve" are connected to the LAN. Each of them has a large volume of hard disks and share them each other via the NFS. Because directory path names follow the rule described above, the data directory path name is exactly the same regardless of which workstations access it. This unification of directory path names is important for parallel processing of KOMB with multiple workstations.

3.2.2 KATS Input files

KATS gets information necessary for the correlation process from the schedule file and log files. The KSP VLBI schedule format is based on standard VLBI schedule format⁽⁶⁾. It must contain the terms \$EXPER, \$SKED, \$SOURCES, \$STATIONS, and \$CODES at least. An example of a log file is shown in Fig. 13. Every log file must contain the following terms:

/LABEL/ Label of the K4 cassette tape. This should be recorded each time when a new tape is mounted in recorder.

/TD/ Clock difference between input interface (DFC-2200) and GPS. This term must be entered at least two times in the log file (at the beginning and the end of the experiment) for the clock parameter of the correlation process.

/ST/ Tape counter number when recording starts for every observation. This number is necessary for

synchronized play back of tapes.

/WX/ Temperature, air pressure, and humidity at the station. This environmental data needs be updated frequently, at least several times per hour. This data is used for atmospheric delay calibration and is stored in Mark-III database together with VLBI observation data.

/CABLE/ Cable calibration data is stored in the Mark-III database and is used to correct changes in cable length in baseline analysis.

3.2.3 Internal files

KATS uses the following internal files (see Fig. 14-1--Fig. 14-4) to memorise the current processing information. When KATS shuts down during processing due to some kind of troubles, these internal files help to enable the interrupted process to be continued.

COR_BASE A file for registering correlator-baseline assignment information and the process flag. This file is modified automatically after stations have been assigned to cassette players.

COR_INF This file is made by collecting information from other internal files at every observation. The CCS refers to it for the correlation process.

COR_MSG Error or warning messages are written by CCS when any troubles occur.

CRSS_PAR Some parameters and flags necessary for correlation processing.

CTL_INF Path name of the internal files are listed.

DB_INF Modified by KATS for making a database and the data is read by db.pl.

ERP_INF Earth rotation parameter is automatically updated by a program called TAKEMIKAZUCHI⁽¹⁾ automatically when a new ERP is sent from IERS.

KHSC_ADR stores hardware GP-IB addresses of equipment.

KOMB_HOST stores candidate of KOMB execution host.

This file is used at "Data Line Connection/KOMB Host Setting" (see Fig. 8).

KOMB_SET KOMB execution parameter.

KROSS_NM Cross correlation output data file has a sequential number such as "K12345". This holds current file names.

MAIL_ADR Mail address where error or warning messages should be sent when any troubles occur.

OBS_DUR Observation start, stop, and parameter reference time (PRT) data for each station.

OBS_INF Observation number, source name, and observation start time are extracted from the schedule file, and tape labels and tape counter numbers for each observation are corrected from the log files.

REC_COR A file to register data cable connection information from recorder to correlator. This file is modified in the "Data Line Connection/KOMB Host Setting" window (Fig. 8).

REC_STAT List of observation stations assignments to cassette tape players.

SRCH_INF Information for fringe search is registered here. In the term \$ORDER, station names are listed in the order of dominance in clock parameter determination. In other words, the lower-order station's clock parameter is changed in the fringe search process. Strong flux sources used for fringe search are listed in \$SOURCE term. \$JDG_LVL is the SNR threshold for automatic judging the fringe detection. \$CMMN_CH is a term to declare channel number by each baseline, whose data is distributed to all correlation units for "clock search" mode.

PRC file Correlation and KOMB process history is recorded in this file, which is located in the prc directory (see Fig. 11). This file shows which observations have been processed.

Table 1 KATS resource list

Category	Resource name	Meaning	Value
Directory resource	dirSkd	Schedule file	~/data/skd
	dirLog	Log file	~/data/log
	dirKRSS1	KROSS dir main	/komb1/vlbidata1/kross
	dirKRSS2	KROSS dir sub	/komb1/vibidata2/kross
	dirKOMB1	KOMB dir main	/komb1/vlbidata1/komb
	dirKOMB2	KOMB dir sub	/komb1/vlbidata2/komb
Remote host information	rhostFiles	Remote host name	kspkog0
	rhostLogin	Login name	
	rhostpasswd	login Password	
	rhostDirSkd	Schedule file dir	~/skd
	rhostDirSkd	Log file dir	~/log
Disc change parameter ⁽¹⁾	kbKROSS1	Disc volume threshold	200000 (kByte)
	kbKROSS2	Disc volume threshold	200000 (kByte)
	kbKOMB1	Disc volume threshold	200000 (kByte)
	kbKOMB2	Disc volume threshold	200000 (kByte)

(1) If the residual capacity of dirKRSS1 is less than the value of kbKROSS1 resource parameter, then kross output dir is changed to dirKRSS2 automatically. Similarly for the dirKOMB.

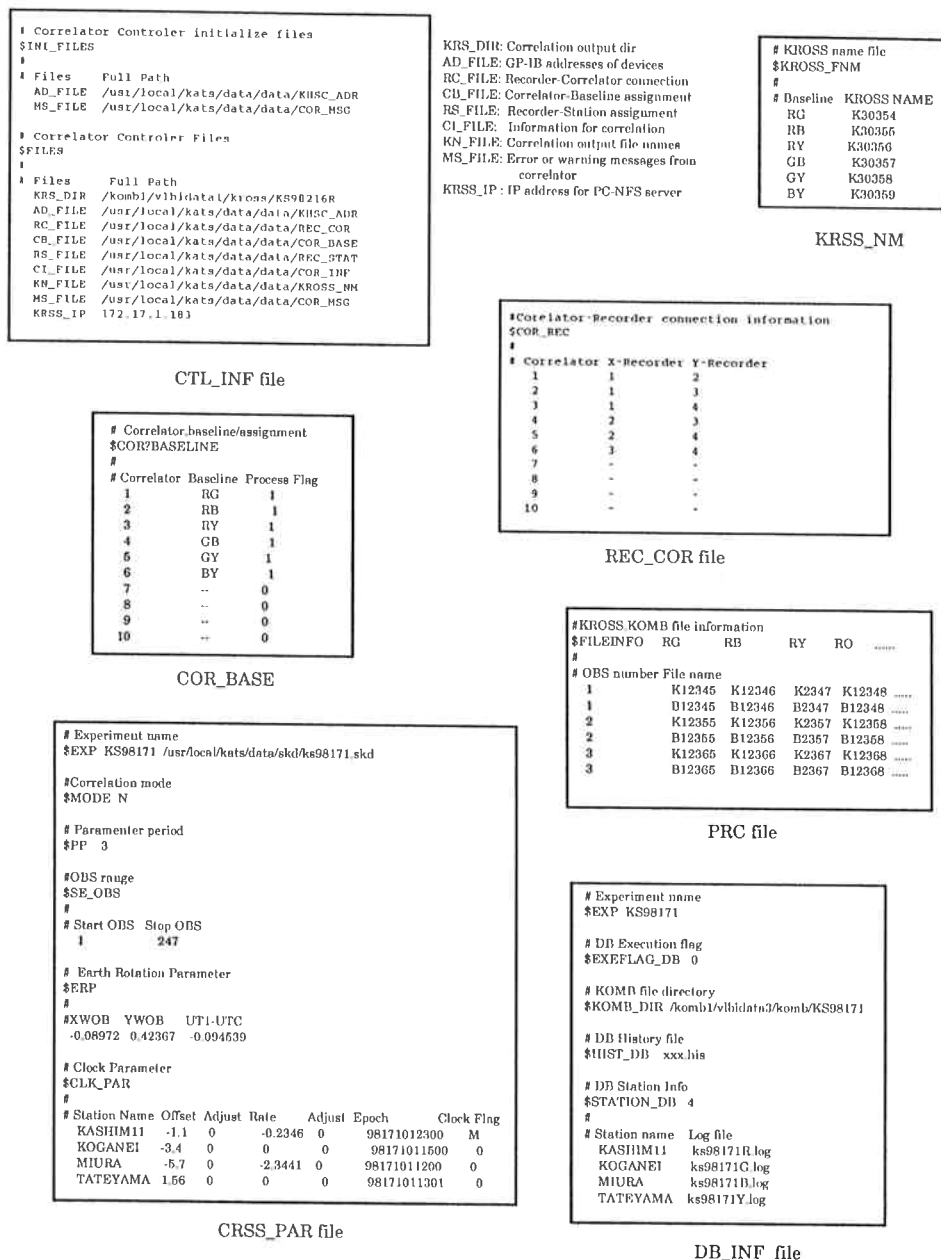


Fig. 14-1 Internal files.

3.2.4 Resource file

KATS uses an X-window system resource file as a KATS set-up file. If KATS is invoked with argument, that is taken as the resource file; otherwise "\$HOME/.Xdefaults-<host name>" is used. Some resource items are listed in Table 1. The full resource list is given in the KATS manual⁽⁹⁾.

4. Features of KATS

4.1 User friendly operation

In the past, VLBI correlation processing required operators to be knowledgeable about VLBI and computers. But KSP system must be operated everyday by non-specialists. Therefore routine operations such as

correlation processing, bandwidth-synthesis, and Mark-III database creation should be easy to perform and should not require much knowledge about computers. KATS is designed to use a GUI so it can be operated by mouse click and a few keyboard strokes.

4.2 Data transfer via ethernet

In the K-3 system, which CRL developed as the first geodetic VLBI correlation system, correlation output data was transferred to the control computer via a GP-IB bus and then transferred to a mini-computer (HP1000/A900) via GP-IB for bandwidth-synthesis (KOMB) processing. Thus the data flow was sequential and the KOMB process needed a lot of computer power. It took two days to process a 24-hour VLBI experiment. Ethernet was

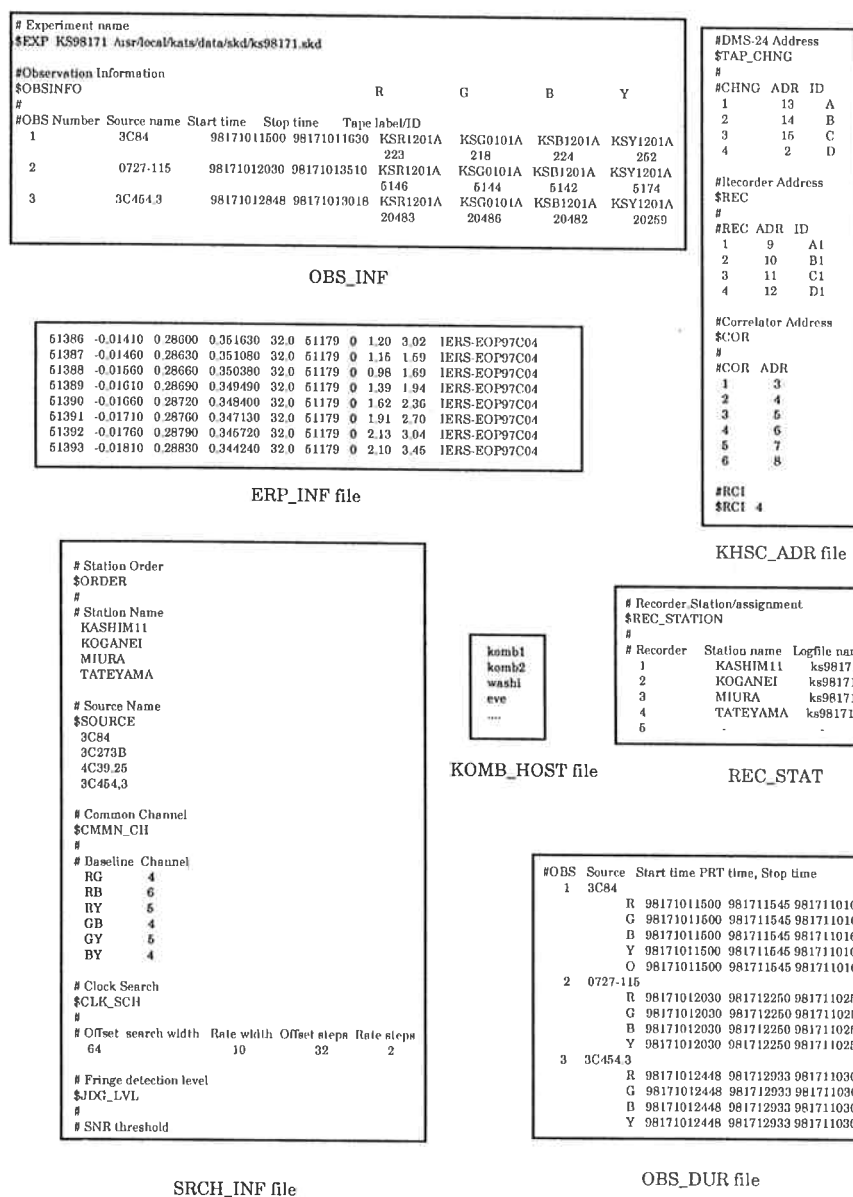


Fig. 14-2 Internal files continued.

introduced in the KSP correlation system. The correlator writes the output data to the hard disk of the host computer and the data can be accessed from any other computer in parallel. Thus the data transfer time became negligible and KOMB processing could be performed while the correlator was performing correlation for the next observation. Consequently, the time taken for the data reduction process became almost as short as the observation time.

4.3 Parallel processing of KOMB

Bandwidth-synthesis processing needs the most CPU power for calculation. To distribute the computation load, the correlation system is designed so that KOMB processes can run in parallel for multiple baseline data streams on multiple workstations. The data to be

processed is shared among the workstations by the NFS, and multiple KOMB processes can access the data independently. The assignment of the baselines to workstations can be controlled from KATS using a mouse (Fig. 8).

5. Summary

The KSP VLBI system is now running every other day to monitor crustal deformation around the metropolitan area. The correlation process is the key to extracting the radio signal propagation delay between two stations. KATS can perform this procedure easily and quickly. And KATS became a basis of farther development to RKATS, which is a fully automated real-time correlation system⁽⁸⁾.

```

#Experiment name
$EXP KS98171 /usr/local/kats/data/skd/ks98171.skd

#Station Position
$STATION_POS
#
# Station name X Y Z Station ID
KASHIM11 -3997505.70170 3276878.40455 3724240.70314 R
KOGANEI -3941937.47909 3368150.90799 3702235.28815 G
MIURA -3976130.02555 3377927.89696 3656753.83841 B
TATEYAMA -4000983.68000 3375276.15000 3632213.38000 Y

#Source Position
$SOURCE_POS
#
# Source name H(ah) Ru(m) Ru(s) Dec(deg) Dec(m) Dec(s)
0059+581 01 02 45.762413 +58 24 11.13656
3C84 03 19 48.160104 +41 30 42.10288
0420-014 04 23 15.800729 -01 20 33.06462

# Frequency Table
$FRQTAB
#
# C Code Subgp Freq Peal VC Mode Bandwidth Pass(track1, track2)...
F LSP-SX KS
C KS X 7714.99 1000.0 1 C 8.000 1(15) 2(16)
C KS X 7724.99 1000.0 2 C 8.000 1(1) 2(2)
C KS X 7754.99 1000.0 3 C 8.000 1(17) 2(18)
C KS X 7814.99 1000.0 4 C 8.000 1(3) 2(4)
C KS X 8034.99 1000.0 5 C 8.000 1(19) 2(20)
C KS H 8234.99 1000.0 6 C 8.000 1(5) 2(6)
C KS H 8414.99 1000.0 7 C 8.000 1(21) 2(22)
C KS H 8524.99 1000.0 8 C 8.000 1(7) 2(8)
C KS H 8584.99 1000.0 9 C 8.000 1(23) 2(24)
C KS H 8584.99 1000.0 10 C 8.000 1(9) 2(10)
C KS S 2154.99 1000.0 11 C 8.000 1(25) 2(26)
C KS S 2164.99 1000.0 12 C 8.000 1(11) 2(12)
C KS S 2234.99 1000.0 13 C 8.000 1(27) 2(28)
C KS S 2294.99 1000.0 14 C 8.000 1(13) 2(14)
C KS S 2384.99 1000.0 15 C 8.000 1(29) 2(30)
C KS S 2414.99 1000.0 16 C 8.000 1(15) 2(16)

# Earth Rotation Parameter
$ERP
#
# XWOB YWOB UT1-UTC
0.02788 0.08708 -0.082901

# Parameter Period
$PP 3

# Correlation Mode
$MODE N

# Clock parameter
$CLK_PAIR
#
# Station name Offset Adjust Rate Adjust Epoch Clock Flag
KASHIM11 -1.1E-6 0 0 0 98171011300 M
KOGANEI -3.4E-6 0 0 0 98171011500 0
MIURA -5.7E-6 0 0 0 98171011200 0
TATEYAMA 1.56E-6 0 0 0 98171011301 0

# Common Channel
$CMMN_CH
#
# Baseline Channel
RG 4
RB 6
RY 5
GB 4
GY 5
BY 4

#Observation Information
$OBSINFO
#
# OBS Number Source name Start time Stop time Tape label/ID
126 1929+226 98171025145 98171025745 KSR1201A KSG0101A KSB1201A KSY1201A
159573 159642 159690 159730

```

COR_INF file

Fig. 14-3 Internal files continued.

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```
$KOMB_HOST    komb1
```

```
#Process nice value
$NICE        0
```

```
# KOMB simultaneous flag
$SIMUL      Y
```

```
# Frequency band
$BAND      S/X
```

KOMB_SET file

```
"Mamoru Sekido" <sekido@crl.go.jp>
"kats" <kats@eve>
```

MAIL_ADR file

Fig. 14-4 Internal files continued.

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