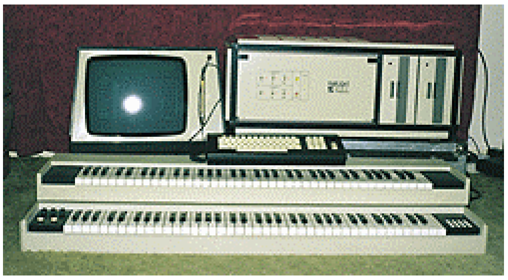
THE FUN OF THE FAIRLIGHT

Fairlight Computer Musical Instrument (Retro)

Published in SOS April 1999

Reviews : Keyboard workstation

Norm Leete waxes lyrical about the mega-synth that introduced sampling to the world back in 1980 and went on to appear on innumerable hit singles and albums.



The Fairlight CMI is a keyboard that most of us have probably never even seen, let alone played, yet it was one of the most prominent synths of the early- and mid-'80s and set the agenda for the way 'ordinary' synths would later develop. Sampling, graphic sequencers, multitimbrality, software-based synthesis and the concept of the 'workstation' can all be traced back to this instrument. Coming from Australia, a country not known for producing synthesizers, this was the keyboard that broke all the established rules, even down to its colour. Consisting of several large (cream-coloured) parts plus loads of cables, it became the '80s digital equivalent of the large analogue modulars that were produced 10-15 years earlier.

Sadly, the downside was a purchase price that most of us could only dream about, as the Fairlight was hand-made using cutting-edge technology that was extremely expensive. I remember the look on my wife's face when we got a mortgage on our first house and I suggested buying a Fairlight with the money instead! The original CMI started at about £18,000, going up to £27,000 for the Series II and finishing up at £60,000 for the Series III. To my amazement, some 15 years later, thanks to Peter Forrest's VEMIA auction, I managed to get a non-functioning Fairlight for less than I paid for my first (second-hand) Ensoniq Mirage. During the restoration of my own instrument I have got to know the machine rather better than I had hoped, as I ended up stripping it down into many parts and rebuilding it from the ground up. From these experiences I can at least give you some first-hand descriptions of what I have discovered along the way!

Worlds Fair

The Fairlight Computer Musical Instrument (or CMI, as it was commonly known) was the result of five years' research. This started in the mid-'70s, when Peter Vogel, an electronics designer, and Kim Ryrie, a synthesizer enthusiast, tried to design a digital synthesizer. Ryrie had already founded a magazine called *Electronics Today International*, for which he had developed a DIY analogue synth, the ETI 4600. Frustrated with the limitations of analogue synthesizers, he suggested to Vogel that they start a company to develop digitally controlled analogue synthesizers, along the lines of the yet-to-be designed Prophet V. In December 1975, they founded Fairlight - named after a hydrofoil that sailed across Sydney harbour - and worked on the synthesizer project for six months with no success until they teamed up with Motorola consultant Tony Furse.

Furse, in association with the Canberra School of Electronic Music, had already developed his own totally digital synth that used two 8-bit Motorola 6800 microprocessors in an unusual parallel configuration. Furse’s instrument synthesized waveforms digitally but couldn’t do harmonic partials, so the sounds that it produced were fairly static.

Vogel and Ryrie were interested in the processing side of the machine, which already featured the light pen and some of the graphics that would later become one of Fairlight CMI’s trademarks. Incorporating Furse’s technology, Vogel, Ryrie and Furse kept working on their digital synthesis idea, and in 1976, after more than a year of hard work, came up with the QUASAR M8. The QUASAR was an eight-voice synth with a keyboard, a QWERTY keyboard, a 2 x 2 x 4-foot processing box with two disk drives and a monitor with a lightpen (sound familiar?). It was huge, it was heavy, it was complex, it was costly, and it was unsuitable for mass production and servicing. Based around 4K of waveform RAM, it consumed about 2kW of power and took ages to start as the system was booted from a paper tape reader. Not an instrument for gigging!

At this point, Vogel and Ryrie licensed the whole design from Furse, and continued to develop the machine for the next couple of years, during which time the price of microprocessors and the peripheral components dropped dramatically. This, along with the realisation that the architecture of the system would have to change drastically to make production feasible, led to the next version of the instrument - the CMI. This was the instrument that some people may remember seeing on *Tomorrow's World* or the Peter Gabriel *South Bank Show* in the early ’80s. One major change was the creation of discrete voice cards, each with their own waveform RAM. The size of the waveform RAM on each voice card was increased fourfold to a massive 16K, whereupon it was realised that there was now enough RAM to store a complete sound instead of just a series of waveforms. To this end a single board was added to the system that could ’record’ real-world sounds so that the voice cards could replay them. ’Sampling’, as this became known, would change the face of electronic music forever (though Vogel and Ryrie thought it was ’cheating’).

The other major contribution was the addition of sequencing to the system, making it a complete ’workstation’ long before the concept was made popular by keyboards such as Korg’s M1.

The huge cost of the Fairlight CMI did not put the rich and famous off. Peter Vogel brought an early CMI to the UK in person, and one of the first people to get one was Peter Gabriel. Once UK distributor Syco Systems had been set up, the client list started to grow. John Paul Jones (Led Zeppelin) bought the first as a replacement for his Mellotron. He was soon followed by Kate Bush, Thomas Dolby, Geoff Downes, Queen, Keith Emerson, Alan Parsons, Stuart Copeland, JJ of Art of Noise, Trevor Horn and Frankie Goes To Hollywood, and many others. Like early modular analogue synths, a fair number of instruments also ended up in studios and colleges. However, they are still not that common, as the total number of CMIs and Series II / IIxs comes to about 300 (of which only about 50 made it to the UK).

By today's standards, the Fairlight CMI (1980-1982) was fairly crude, and it was superseded by the more common Series II (1982-1983). Due to the modular nature of construction, however, CMIs could be - and often were - upgraded to Series II specifications along the way (I think my own machine has been through this process). The main improvement was an uprating of processing power, allowing the addition of 'Page R', the first ever graphical pattern-based sequencer. Enhancements continued with the Series IIx (1983-1984), which included a fully integrated MIDI/SMPTE system and improvements to the fidelity of the sampling and the software. Finally the decision was taken to abandon 8-bit technology and the Series III came out in the mid '80s.

What You Get For Your Money

A 'standard' Fairlight CMI Series II consists of a system mainframe, a monitor with lightpen, a QWERTY alphanumeric keyboard and a six-octave master keyboard. There were also additional options, including a six-octave s

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lave keyboard and an analogue interface to allow the CMI to control eight analogue synths. Later additions included a SMPTE/MIDI interface and better sound cards.

The mainframe houses the main processors, the disk drives, the power supply and the audio electronics. It is not small, measuring 750mm x 450mm x 320mm and weighing in at 40Kg (I can barely lift it unaided). At the right-hand end are two 8-inch disk drives. The left-hand one of the pair (drive 0) is used mainly to retrieve the system software (and various overlays) from the boot disk, while the right drive is used to load and store sounds and sequences. If a QDOS disk is loaded instead, the machine will boot up as a normal computer, which is how you make backups of the system disks and format sound disks. The mainframe is the hub of the system, to which all the main connections are made. All audio connections are via 'cannon' plugs and sockets at balanced line level. Other connections supply power to the monitor and the six-octave keyboard, and there is also a data cable from the keyboard (all the peripherals are have their own processors and communicate via a proprietary serial buss, a bit like MIDI but at about a third of the speed).

In more detail there is (starting from the left-hand end):

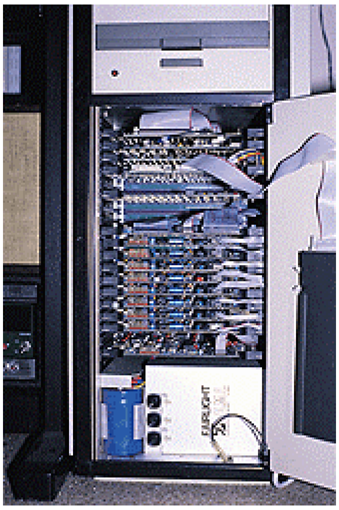
- Power on. This is the only synth I have ever known with an ignition key!
- Mains in and out (for the monitor).
- Keyboard power.
- Keyboard in - a 9-way D-type connector that carries the serial data back from the keyboard.
- Graphics, which carries the video out to the monitor and the lightpen signals back to the mainframe.
- Printer, which allows an RS232 serial printer to be added to the system.
- Headphone output, which also carries the metronome click for use with the internal sequencer.
- Monitor speaker output for a 20W speaker
- Eight individual outputs (one from each voice card) and a mix output.
- Sync in and out, mainly for synchronising to tape.
- Sampling filter out - allows monitoring of the effect of the sample A-D converter on the input signal in
- Click vol - controls the level of the metronome signal.
- Mon vol - controls monitor output level.
- Mic in/ADC ext and ADC int/line in - switches to control the sample input source.
- Mic and line level inputs, plus an ’ext ADC’ input for use with an external analogue-to-digital converter.

One of the most distinctive features of the CMI’s user interface is the lightpen attached to the monitor. The optics in the pen can detect the spot passing on the screen, and as the time from the origin is known, this can be used to calculate the coordinates of the current pen position. The pen also detects when the user touches the tip, which is used as confirmation of selection. The software highlights various parts of the screen, so a combination of the two gives a very interactive user interface. In use this means you can point and shoot for most of the functions (although 95 percent can be driven more conventionally from the QWERTY keyboard).

The six-octave keyboard is a very wide and deep unit. This does not make sense until you see it with the slave keyboard perched on top, where it sits perfectly. The keyboard has its own processor to cope with all the key scanning and real-time controls. These consist of three (quite tacky) sliders and two (illuminated) switches to the left of the keyboard. One switch is latched, the other is momentary and all these controls can be assigned to all manner of parameters. To the right of the keyboard is a setup that looks like a built-in calculator, but is in fact a simplified user interface that can be used to select sounds instead of the QWERTY/monitor set up - the idea being that for live gigs (gulp!) you left the monitor at home and used just the main unit and the keyboard, using the keyboard user interface to call up pre-programmed sounds. The slave keyboard connects to the main keyboard and gives you another six octave F-F keyboard. The main keyboard has a quite heavy action (which piano players seem to like), while the slave keyboard has a light synth-style action.

Software

Perhaps the most important element of the system is the software, as this determines what everything does. The user is presented with 18 different menu pages (plus 2 additional ’hidden’ pages) which control the different functions of the instrument. Each page has a number of related ’help’ pages that can be viewed at any time by typing ’H’. These pages contain most of the user manual ’on-line’ and are extremely helpful.



Page 1, INDEX, lists all the pages, which can be selected using the lightpen or by typing, for example, ’P2’ into the QWERTY keyboard.

Page 2, DISK CONTROL, allows the user to view the files on disks used to store sounds, sequences and the like. From here you can also load and store files.

Page 3, KEYBOARD CONTROL, allows the user to determine keyboard splits, voice allocation, tuning and so on. The entire setup can be stored as an ’instrument’ file so these can be recalled easily - eight completely different sounds can be recalled and allocated different keyboard regions by loading just one file.

Page 4, HARMONIC ENVELOPES, allows the user to create new sounds using the lightpen to draw envelopes that describe the amplitude and duration of 32 harmonics in 32 wave segments. This is a bit like a PPG Wave or a Wavestation, except that you can also manipulate the contents of the wavetable as well! This is not a real-time system as the system has to go off-line for a number of seconds to compute the waveform and then fill the memory in the voice cards.

Page 5, WAVEFORM GENERATION, is an alternative way of manipulating the wave segments. It displays 32 harmonic sliders that are set up to reflect the desired level of each harmonic. Again these need to be calculated and then transferred to the voice card before they can be heard. This is not as bad as it sounds, as you only need to build a few of the required ’key’ wave segments, after which you can get the CMI to work out all the in-between waveforms using the merge function on page 6.

Page 6, WAVEFORM DRAWING, is another way of manipulating the wave segments. All you do is draw or plot the desired shape and then transfer that to the voices. Some help is given by having some of the conventional waveshapes such as sawtooth, square and triangle available as 'macros'. This page also has the very powerful 'merge' function that allows the user to define start and end segments and then gets the Fairlight to compute all the in-between segments.

Page 7, CONTROL PARAMETERS, allows the user to control looping, portamento, glissando, attack, damping (decay), voice mode and how the real-time controls are assigned. For example, it is possible to control loop length and loop start in real time as part of the patch.

Page 8, SOUND SAMPLING, allows the user to sample real-world sounds and to control sampling parameters such as sample rate, filter frequency, and so on. As you can see, sampling is but a small part of the system - and all of the wavetable manipulation on previous pages can be carried out on a sampled voice.

Inside the Fairlight's mainframe, the system hardware is contained on 15 circuit boards in 20 slots. Slot 1 contains the Master Card, which includes the system timers for the sequencers, the analogue-to-digital converter used for sampling, and the control logic for the eight sound cards. Slot 2 is usually empty, although I have seen the optional SMPTE/MIDI card here, while slots 3-10 contain the Sound Cards, each of which has all the elements of a monophonic sampler. All eight cards are identical and can be freely swapped, which is useful when confronted with a faulty CMI. Each card has its own sample RAM (16K), tracking filter, control logic and digital-to-analogue converter. All eight cards share the same memory space with access being controlled from the Master Card in slot 1, allowing any combination of sounds to be loaded. If 8-voice polophony is required then the same sound is loaded into all 8 cards simultaneously. Unlike most instruments of today, this means each voice is created individually before being mixed as analogue signals, giving a very rich sound.

Slot 11 is for the optional analogue control card, which can have up to 16 inputs and outputs, with the usual configuration being eight CVs and eight gates. Slots 12 and 13 are usually empty, while slot 14 contains a 64K (in the series II) or 256K (in the IIx) RAM card for the main operating processors. In the early '80s, 256K was a huge amount of RAM! Slot 15 is usually empty, while slot 16 houses a peripheral card that allows output and input to and from the keyboards and the switches on the front panel. This card also contains the power-on start-up logic and the boot ROMs that get the system into a state where it can read the full operating system off of the system disk.

Slot 17 houses a twin processor card. One of the cleverest features of the CMI is the way the system is controlled by two microprocessors working in an interleaved manner. This was done by generating clock signals from a master clock running much faster than usual, and then dividing the frequency into a series of time-slices. This means that the processors are run in turn, so that when processor 1 is active on the main data/address busses, processor 2 is idle. This allows tricks such as reading data from the disk and then buffering it as a background task. In this way Page R/Page 9 can play very long sequences, with many disk accesses while the sequence is playing, without upsetting the timing of the sequence.

Slot 19 houses a video card, which contains all the logic and RAM to generate the video displayed by the monitor. Integrated into this board is the lightpen interface that determines where the lightpen is being pointed on the screen by measuring the X-Y position of the spot on the screen with respect to the video signals. The final slot, slot 20, contains the low-level hardware that controls the floppy disk drives.

Page 9, KEYBOARD SEQUENCER, is a simple real-time sequencer with minimal editing.

Page A, ANALOG INTERFACE (sic), is the optional analogue synthesizer controller, which can also assign up to 16 analogue inputs that to parameters on Page 7, allowing possibilities such as voltage control of loop parameters and filters.

Page C, MCL COMPOSER: the Music Composition Language (MCL) is a full-blown language interpreter that uses a ’language’ optimised for musical composition. Though it is not the most intuitive interface, MCL makes it possible to compose pieces with amazing accuracy and complexity. It is a ’tree-structured’ language with three levels of hierarchy; ’pieces’ are built up from ’parts’ that have ’sequences’. Those who use it maintain that it is a very good way to use the full power of the system.

Page D is the WAVEFORM DISPLAY that most people were photographed with (you know, the pictures of mountains). It is a very useful aid to getting sampled voices tuned, as it displays the whole waveform memory in one go. If the display looks ’pretty’ it is a good bet that all is well, while jumbled or confused waveform dumps show that the sampling rate was wrong or that clipping took place.

Page F is for USER DEFINED FUNCTIONS, which allow things like velocity profiles to be defined.

Page I, SMPTE CONFIGURATION, allows the user to configure the optional sync interface that gives accurate timing for use with film or TV work - a sign of what was to come.

Page L, DISK LIBRARY, allows the user to catalogue and sort up to 80 sound disks. As this catalogue data is written to the system disk (which is always in the CMI while it is running) it can then be used to find previously stored sounds, telling you which disk to insert in the other disk drive. Cunning!

Page M, MIDI CONFIGURATION, allows the user to configure MIDI in and out on one of four channels (A-D), giving a total of 64 channels. Further investigation is hampered on my system by lack of MIDI hardware, as this was a feature that only appeared on the Series IIx.

Page R, REAL TIME COMPOSER, was a brilliant addition to the Series II that gave the world the first integrated graphical pattern-based sequencer. Each note in the sequence has the time value displayed in a horizontal strip. The note value can be edited in the other half of the display. In a similar way to programming a drum machine, Page R allows the user to build up a series of up to 255 patterns with up to eight monophonic parts in each. These patterns could be combined into up to 26 phrases (A-Z) allowing complex pieces to be constructed. Page R also introduced the idea of quantisation and, as the whole system could read the disk drives as a background task, the sequence could be larger than the available memory, as sections would be read in just before they were required.

Page S, SCREEN PRINT, allows the user to define how the screen display will be sent to a printer.

Page G is a hidden page which allows the user to view the values in a voice as a table of figures. I think it is meant for troubleshooting only, although it has allowed me to experiment a bit with Page 4 without the lightpen (or a safety net!).

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Page T is called TEST! I found this undocumented page by accident when trying to troubleshoot my own faulty instrument. It can display the status of most of the system in real time, allowing the user to see where problems may be, and it's fun to watch even when all is well - marvel at the sight of keys being captured in a buffer, and watch as each voice card is assigned a channel, plays through its voice, and is then released for the next note!

The standard system also came with the Fairlight Library which consisted of 29 disks - 28 sound disks plus some demos of MCL and Page 9. A large number of the sounds were to find their way onto well-known albums in the '80s. Sounds of note include ARR1, SAXY, SWANNEE and PWANG, while a sound to avoid like the plague is ORCH5 (yes, that orchestra hit!).

Fairlights can, unsurprisingly, be had these days for a fraction of their new price. The original CMI seems to go for about £1200 in good condition, while you can expect to pay about £1500 for a tatty Series II that works, and in the region of £2500 for a mint Series IIx with MIDI. Series IIIs fetch about £4500 - and remember that finding 8-inch disks of the right sort can be fun!

Fair Sound

Finally, how does the Fairlight actually sound? Well, I was astonished at the quality for an 8-bit system. The bass the CMI can generate is awesome with an ability to move furniture, and the signal-to-noise ratio is good. Sounds created by the mathematical functions on pages 4 and 5 can be very bright and quite DX7ish (without the hiss). Sampled sounds can suffer from aliasing noise as the maximum sampling frequency is only 32kHz (about the same as a Mirage). To me this is part of the charm of the system - there’s nothing wrong with a bit of grunge. It should also be remembered that the CMI was primarily designed as a digital synthesizer with sampling as an add-on. Used in this way I feel it still has a lot to offer (I would say that, having bought one!). I also have found that page R makes you write music in a different way, as it’s similar to using eight monophonic synths, which affects the way you arrange things.

When I bought mine, I thought ’it’s only 8-bit, it’ll sound awful - I can always sell it once I’ve sampled it’. Well, for once, that is not true, as the original always sounds better. I now understand why people were prepared to pay so much money for ’that sound’. I chose the house instead, and had to wait 15 years, although I can never boot up the Fairlight without a wry smile. One to keep... SOS