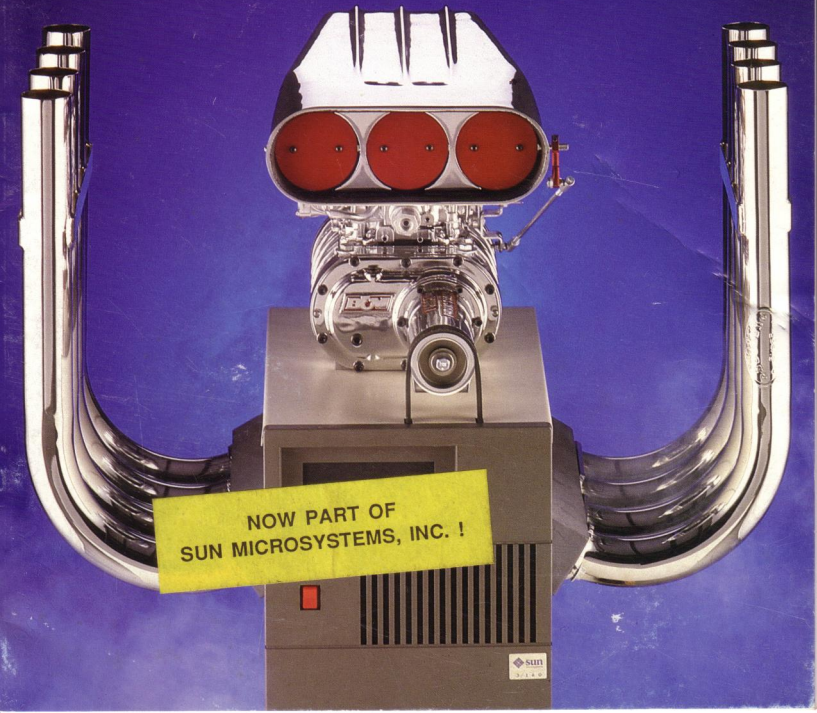
SUPERCHARGE YOUR SUN.

Trancept Systems Inc.



The TAAC-1 board set plugs into Sun Microsystems Workstations to speed application processing.

INTRODUCING THE TAAC-1™ APPLICATION ACCELERATOR FROM TRANCEPT™ SYSTEMS

Trancept's TAAC-1 Application Accelerator is an ultra-high performance processor with integrated full color display – and the capacity to speed up your applications 20 to 100 times.

Just plug the TAAC-1 into your Sun Microsystems® Workstation to boost computing power for analysis, graphics and imaging related applications. The TAAC-1 is specifically designed to increase interactivity and productivity in computationally intensive areas such as geometric modeling, high quality rendering, image processing, finite element analysis and simulation.

Trancept Systems was established in late 1985 to meet the need for increased interactivity in graphics and imaging related applications. Drawing on their combined 30 years of experience in high performance graphics and imaging hardware and in application specific software, Trancept's founders identified the need for an application accelerator.

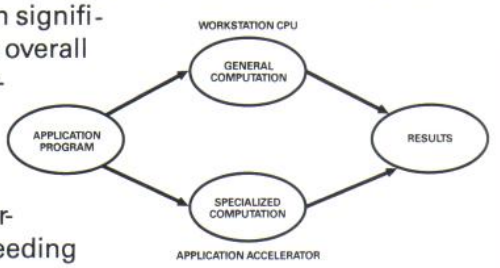
The Power You've Been Waiting For.

What is an application accelerator? It's an add-on processor dedicated to executing the critical computations in an application. Now the most compute-intensive portions of an application program can be off-loaded from the workstation CPU to the applica-

tion accelerator in the same way transformation and drawing tasks are often off-loaded to an attached graphics processor.

Application software is typically a mix of operations that set up the problem and actually do the work. In computationally intensive applications, most of the program's time is spent actually doing the work. A bottleneck develops because the specialized application processing must compete for CPU cycles with operating system, user interface, artificial intelligence, data base management, window and networking tasks.

By moving the time-consuming parts of application processing to an optimized accelerator like the TAAC-1, you can significantly increase overall application performance. The TAAC-1 breaks up the bottleneck in the interactive loop, speeding application processing and reducing the time it takes to see your results.



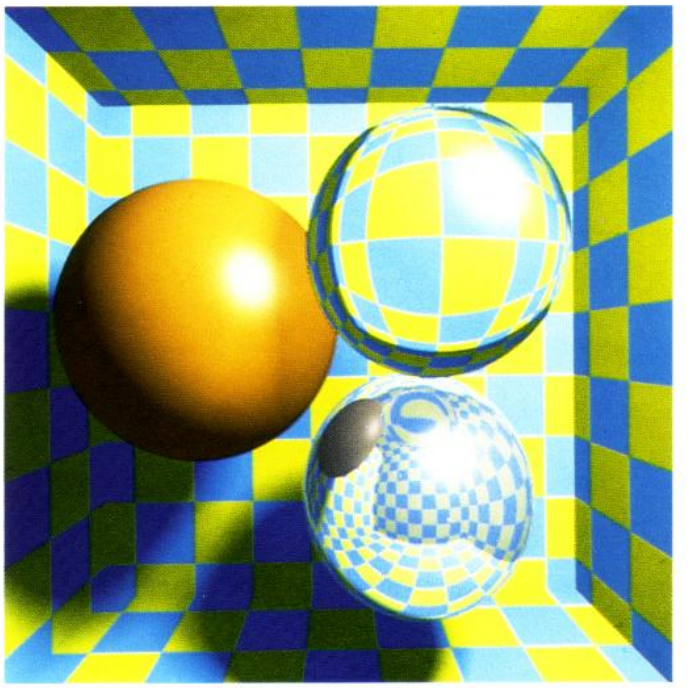


Image ray traced on the TAAC-1 with antialiasing, soft shadows, reflections, and transparency with refraction.

The TAAC-1 Advantage.

When interactivity and application throughput are critical, you need a processor dedicated to the application: Trancept's TAAC-1 Application Accelerator.

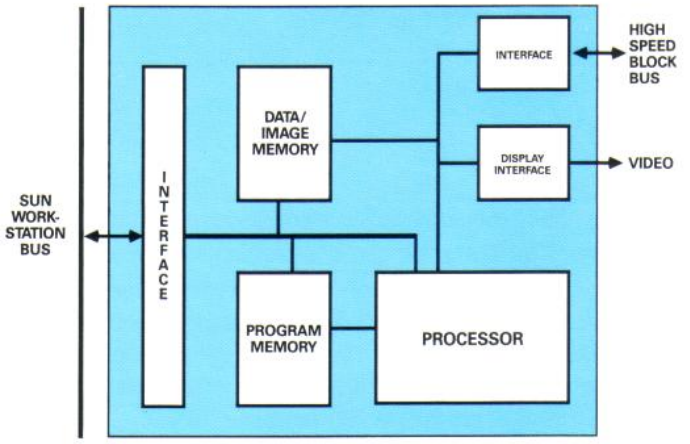
The TAAC-1 applies all of its power to solving your application problems. While the workstation CPU is busy handling the tasks that it does best, the TAAC-1 is concentrating on the main task–quickly and efficiently executing your application program.

The TAAC-1 is a low latency SIMD architecture processor with the unique capability of generating a full color video display from its data memory. A fully programmable processor, the TAAC-1 is optimized for applications with spatial or geometric data structures. The TAAC-1 architecture offers all the processing elements, memory, and data paths needed for superior performance across the wide range of problems in this class.

The TAAC-1 data memory is multi-ported and multi-purpose, and can be used to store both data and images. In addition to a random access port, the data/image memory has two very fast vector ports. These vector ports give access to sequentially stored data at video rates for display, and at processor clock rates for processing. They can also be used as a general purpose, high speed block transfer interface to the TAAC-1.

For maximum efficiency in transferring data and control information between the TAAC-1 and the workstation CPU, the TAAC-1 is memory mapped into the Sun address space and has a full master/slave interface to the workstation VME bus.

The TAAC-1 incorporates the best features of a highly programmable graphics processor, an array processor, a floating point accelerator, a mini-supercomputer and an image processor. The TAAC-1 architecture, general purpose yet highly tuned for targeted applications, offers, in a flexible, programmable device, performance rivaling that of dedicated hardware.



TAAC-1 ARCHITECTURAL FEATURES

The TAAC-1 processor is implemented with a new VLSI processor family which has a three-port, low-latency (non-pipelined) architecture. The TAAC-1 contains several processing elements which are connected by multiple high speed data buses.

The TAAC-1 is a very wide instruction word computer with a 250 Mbyte/second instruction path. The wide instruction word is necessary to control operation of the processing elements and the the flow of data on the processor buses. Wide instruction word architectures offer maximum processing efficiency, since multiple operations can occur in parallel in each instruction and all instructions complete execution in one cycle. Because a C compiler is available, no complicated assembly language programming is required.

Processor

Dual 32 bit Integer ALUs: In applications with complex data structures, a second ALU gives the ability to perform pointer calculations in parallel with data calculations, a significant performance advantage. Analysis and image processing gain efficiency by using the dual processors to compute X and Y address values simultaneously rather than sequentially. Under software control the ALU's can be configured as four 16 bit or eight 8 bit processors.

Floating Point Processor: The 32/64 bit floating point processor offers add, subtract and multiply functions. Division is supported using the Newton/Raphson algorithm. Single and double precision operations are available for applications which require high precision, like analysis or signal processing, or a very large range of values, such as geometric modeling.

Integer Multiplier/Accumulator: For inherently integer processes, as well as structure and multidimensional array address calculation, the integer multiplier/accumulator offers significant speed improvement over multiply operations executed in software.

Register File: A six port, 128 word register file is available on the processor buses. Data stored in these register files is immediately available as an input to any of the processing elements. The size of the file means that for an application like image processing, an entire 8×8 convolution kernel can be held in the register file.

Barrel Shifter: The TAAC-1 includes a barrel shifter to allow single cycle bit shifting. This capability is useful in imaging and graphics applications to pack and unpack image data.

Look-Up Tables: Frequently used mathematical functions such as sin, cos, square roots, and reciprocals can be accessed from PROM look-up tables using Trancept supplied software. Trancept also provides support for RAM look-up tables with up to 8K entries.

Sequencer: The microsequencer supports real-time interrupts and hardware breakpoints for easier debugging.

Memory

Data/Image Memory: The data/image memory is 8 Mbytes. The large size of this local memory means that the TAAC-1 can hold the entire data set for many problems. For instance, an entire 1000×1000 matrix of 32 bit values can be downloaded for an analysis problem. The TAAC-1 is free from any workstation bus bottlenecks that may limit performance.

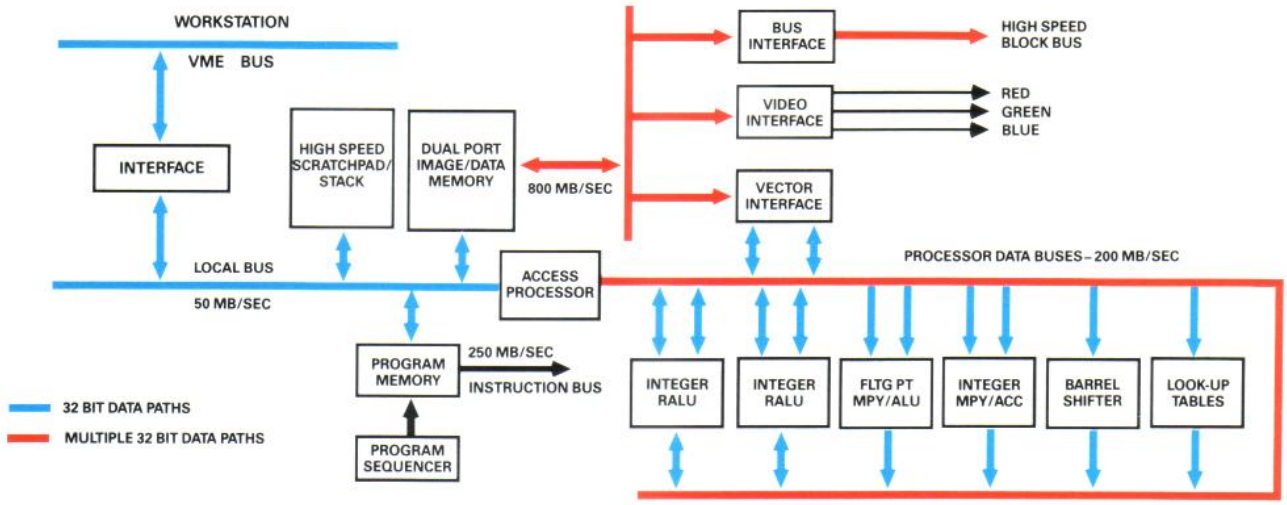
The data/display memory can be used in linear, 2-D, or 3-D modes. The memory may be partitioned under software control and used in multiple modes simultaneously. A typical usage combines one full color 1024×1024 image for display and 4 Mbytes of data store. For medical applications, the memory can store a $256 \times 256 \times 64$ voxel data set and display a 512×512 image, with 3 Mbytes left for additional data.

Program Memory: The program store is 400K bytes for 16K instruction words.

Scratchpad/stack: The TAAC-1 includes a 16K word scratchpad or stack memory on the local bus. This memory is useful for communication between the TAAC-1 and the Sun, and for storing frequently used variables. Built with ultra high speed static RAM, the scratchpad memory can always be accessed by the processor in just one cycle time.

Data Paths

Vector Ports from Data/Image Memory to the Processor: Vector data ports from the data/image memory to the processor can supply two 32 bit values each processor clock cycle, for a sustained rate of 80 Mbytes/sec. These ports support typical vector applications such as signal processing and analysis. In image processing applications, one of the bidirectional ports can be used to read source data and the other to store results.



Because vector overhead is very low, the vector ports provide the most efficient data path for data sets as small as the 64 control values of a bi-cubic patch.

Access Processor: The TAAC-1 includes a proprietary access processor which enables the arithmetic processors to transparently address the data/image memory in 2-D or 3-D mode without additional overhead. The access processor generates the correct physical address from the multidimensional address. Your program can use the data format which is most natural for the application without incurring memory access time penalties. The access processor also includes local neighborhood cache control for maximum efficiency.

Software Reconfigurable Processor Pipeline: The processing elements can be connected to the various processor data buses under program control. This software control of source and destination for data and results allows the processing elements to be formed into application specific pipelines. This feature means that the TAAC-1 performs like special purpose pipelined hardware, while retaining the flexibility to address a variety of applications.

Software

The TAAC-1 is programmable in the C language. A C language preprocessor, compiler, and development tools are available. A monitor provides start/stop/continue, peek/poke, and push/pop functions. The symbolic debugger supports breakpoints and single stepping. A profiler generates run-time statistics needed to optimize performance. Other software tools include a relocatable linker, loader, driver, and power-up and maintenance diagnostics.

Display Features

Flexible image memory: The data/image memory can store up to 1024 × 2048 pixels. The size of the displayed image is user selectable up to 1024 × 1024. The refresh rate is 66 Hz non-interlaced. For standard video applications, the system supports a 640 × 480 pixel, 30 Hz interlaced mode.

The basic pixel in the TAAC-1 is 32 bits deep (32 bit planes). These bits are organized into four 8 bit channels which can be displayed as four independent 256 color images. Look-up tables on the output give a palette of 16.7 million colors.

The fourth channel is always available for use as an 8 plane overlay. Each plane can be assigned a single color, or the planes can be used together for up to 255 overlay colors. The available palette is 16.7 million colors.

For full color display, the channels can be assigned to red, green, and blue. The fourth channel, alpha, can be used for application specific storage, such as opacity for transparency calculations, or for overlay. Look-up tables on the outputs of the full color display add flexibility for operations such as gamma correction.

Full color display on the Sun Workstation® screen: The TAAC-1 allows you to open a window on your color Sun Workstation and display a full color – 24 bits/pixel – image from the TAAC-1 data/image memory in it. If your application requires it, the TAAC-1 can drive a separate color monitor.

Genlock to external sync: The TAAC-1 will lock to an externally applied sync signal. If using the Sun monitor for display, the TAAC-1 locks to Sun sync. For broadcast video applications, the TAAC-1 can be locked to a master NTSC signal.

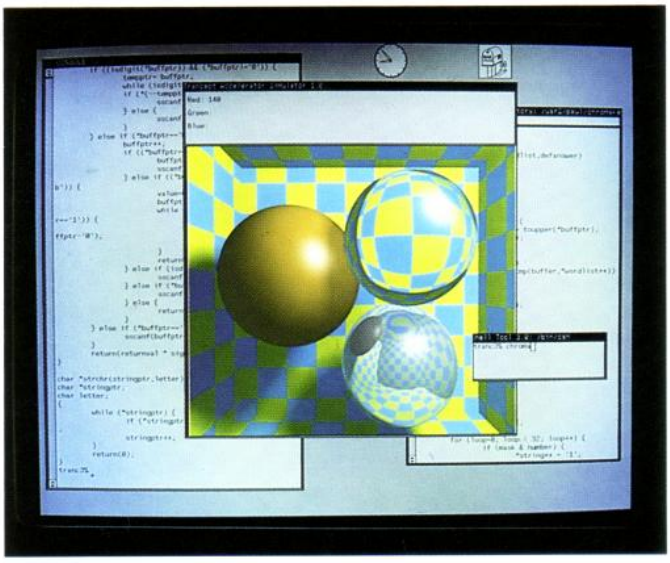
THE SOLUTION FOR YOUR APPLICATIONS.

The TAAC-1 unites in one device the best features of a single purpose accelerator and a general purpose computer. The performance of optimized hardware and the flexibility to handle a range of high performance applications.

The TAAC-1 architecture is highly tuned for performance, incorporating hardware support for application specific functions. Its highly programmable nature and high level language support give it flexibility and ease of use. The TAAC-1 Application Accelerator for all your analysis, imaging and graphics related applications.

High Quality Rendering

When your application requires drawing techniques more sophisticated than Gouraud shaded polygons, choose the TAAC-1. You can use the C language to program your own proprietary rendering algorithms for the TAAC-1, off-loading these time-consuming tasks from the host CPU. Rendering times for algorithms like ray tracing will be so brief that in an overnight run you can produce an entire animated commercial instead of just a single frame.



Full color TAAC-1 image in a Sun window.

Analysis

The best of both scalar and vector processing–scalar flexibility and vector speed–are yours with the TAAC-1. The TAAC-1 eliminates restrictions on data storage format and program control flow. With the TAAC-1, you can accelerate your analysis software without having to reformat your data or contort your algorithms to fit inflexible hardware.

Modeling

It's easy to speed up geometric modeling on your workstation with the TAAC-1. The TAAC-1's flexible architecture means that recursive and adaptive algorithms are no problem, while the C compiler makes it simple to handle complex data structures like linked lists. With Trancept's proprietary memory access hardware, you can address your 2-D data arrays in a natural (x,y) or (u,v) format without incurring additional overhead. To top it off, you can display your results directly from the TAAC-1–in a full color window on your Sun color monitor.

Image Processing

The TAAC-1 has what you need for image processing–large memories for multiple buffers, single and double precision floating point for operations like FFT's, and user programmability so you can run your custom algorithms.

Bidirectional vector ports from memory to processor make the TAAC-1 as fast as dedicated pipelined architectures for convolution and warping–without the inherent limitations of inflexible hardware. A high speed local bus gives you the fast random pixel access needed for algorithms like median filtering and object recognition. The TAAC-1 gives you all the features you need for image processing–in one product.

Simulation

The simulation market demands computational performance. The TAAC-1 delivers, accelerating your workstation 20 to 100 times. For example, the combination of floating point processing and graphics/imaging display makes the TAAC-1 perfect for radar image simulation. High performance puts the TAAC-1 in the class of mini-supercomputers. Its price makes it an affordable personal resource.

TAAC-1 Specifications

Processor
Dual 32 bit integer ALUs
Six port 128 word register file
32 bit integer multiplier/accumulator
64 bit floating point processor
Barrel shifter
Interruptable Sequencer
PROM function look-up tables
Application specific RAM look-up tables

Memory
Data/image: 8 Mbytes addressable as:
- 2M words -or-
- 1024 × 2048 words -or-
- 256 × 256 × 128 bytes
- Configurable for combinations of data and image storage under software control

Program: 400K bytes (16K instructions)
Scratchpad/Stack: 16K words

Software
C language compiler
Symbolic debugger supporting breakpoints and single step
Tools: relocatable linker, loader, monitor, driver, diagnostics and profiler

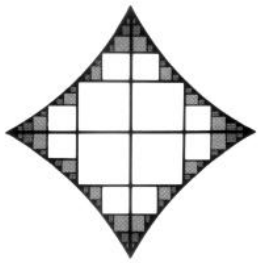
Display
66 Hz, non-interlaced -or- 30 Hz, interlaced
1024 × 1024 pixels -or- 640 × 480 pixels
32 bits/pixel software configurable for multiple formats:
- 4–256 color channels at 8 bits/pixel -or-
- 1–16.7 million color channel (24 bits/pixel)
  - with 255 color overlay/alpha channel (8 bits/pixel)

Look-up tables for palette of 16.7 million colors
Output to window on Sun Color Monitor
Output to separate color monitor (optional)
Genlock to external Sun sync or NTSC sync

Sun Compatability
Compatible with Sun-3™/160/180, Sun-3/260/280
Requires 2 adjacent backplane slots
Can use any backplane locations
Does not restrict use of Sun P-2 bus

Mechanical
Two 9U × 400mm Eurocard standard boards joined to form one unit:
- Processor
- Memory/display

*Specifications are subject to change without notification.



Trancept Systems Inc.
New Address, April 1987:
500 Uwharrie Court
Raleigh, NC 27606-1455
919/828-7406