SP2000

MOTION ANALYSIS SYSTEM

WELCOME TO THE WORLDS OF MOTION ANALYSIS

A WORLD OF INSIGHT

There are many examples of beautiful high-speed images enjoyed by us all—a bullet frozen in flight, a milk-drop tiara, a humming bird poised with motionless wings. Perhaps you're more familiar with the Sunday afternoon athlete, slowly tumbling, twisting, reaching for that agonizingly slow football arching down just out of reach. Or maybe you're one of a growing number who use high-speed motion analysis in their work, studying in great detail events which are just too fast to be seen with the unaided eye.

This is the world of motion analysis, recording a great number of pictures during an event, and then playing them back slowly to analyze the movement which has occurred in step-by-step progression. It's a world previously open to only a few specialist practitioners, a world now open to you through advanced technology from Spin Physics.

USE OF A SOLID-STATE VIDEO SENSOR DEVELOPED BY KODAK ALLOWS A VERY SMALL CAMERA TO PRODUCE UP TO 12,000 PICTURES PER SECOND.

A WORLD OF ANSWERS

Practical, real-life applications for motion analysis surround us everyday. For decades engineers, scientists, and photographers have used this powerful technique, and there have been many books and articles published on successful solutions to a wide variety of products and problems. Included are such applications as the following:

- Paper-making and converting machinery
- Primary and secondary metal-forming processes
- Transportation systems development, crash testing
- Packaging equipment
- Aerospace hardware development
- Gear train, kinematic analysis
- Vibration studies
- Biomechanics
- Printing press operation
- Fluid mechanics, wind tunnel, and cavitation studies
- Ballistics

Similar application possibilities exist in virtually every branch of science, engineering, and production, providing opportunity for savings in time and money.

TYPICAL OF PRODUCTION APPLICATIONS, THIS CUTTING TOOL STUDY CAN LEAD TO INCREASED SPEED AND EFFICIENCY IN THE MACHINE SHOP.

A WORLD OF TODAY

For over twenty years high-speed imaging has been confined to the technologies of the 1950s and '60s. Now comes a series of breakthroughs which moves motion analysis up into the '80s. The SP2000 system is the motion analysis system for today, combining State-of-the-Art advances in video sensors, video recording, magnetic tape, and electro-mechanical design. The result? An instrument which delivers astounding performance and is so easy to use it will quickly become an indispensable tool.

CUSTOM, MINIATURIZED ELECTRONICS AND ADVANCED PACKAGING TECHNIQUES MAKE THE ANALYZER CONSOLE EASILY TRANSPORTABLE.

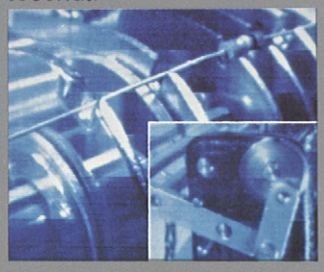
A WORLD OF PERFORMANCE

INSTANT RECORDING OF HIGH-SPEED EVENTS

Using patented video techniques, the SP2000 system captures events as they happen by recording from 60 to 2,000 full pictures per second. In the split-frame mode, the picture may be divided into 2, 3 or 6 horizontal segments, achieving speeds up to 12,000 pictures per second. All speeds are instantly selectable.

EXTENDED RECORDING TIMES

Ultra-high density data recording provides recording times of almost 8 minutes at 200 frames per second and 45 seconds at 2000 frames per second. And, due to the unique recording format of the SP2000 system, the recording time at 12,000 pictures per second is also 45 seconds.



BOTH CAMERAS ARE BEING USED TO SIMULTANEOUSLY RECORD TWO DIFFERENT VIEWS OF THE SAME ACTION.

DIRECT, LIVE VIEWING

There is no guessing at proper exposure, framing, focus, or lighting. There are no complicated calculations. Just watch the live results on the monitor or camera video viewfinder as you adjust the controls. Everything can be set for perfect results, first time, every time.

INSTANT-REPLAY SLOW MOTION

Push-button controls allow instantaneous slow motion tape review after recording with no delay for processing. A microprocessor automatically searches out the beginning of the last recording, and the tape is played back in continuous slow motion. You can also choose one of four JOG-MODE™ playback rates allowing step-by-step replay. And, there is a single-picture advance feature which allows manual choice of specific frames for study. The JOG-MODE playback and single-picture review features also work in reverse. Use the auto-playback to be sure you have captured the right information; use the JOG-MODE playback to analyze a phenomenon on the spot. You can even change a parameter, rerun the test, and compare results within seconds.

FREEZE-FRAME DISPLAY

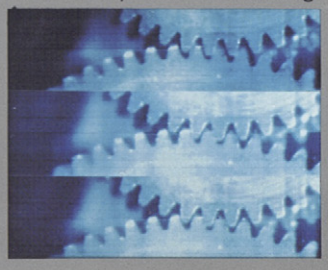
Use of a digital buffer memory permits flickerless, full intensity pictures to be displayed indefinitely, with the tape recorder inactive. This allows you to perform a detailed study of an image with no noise bars and no tape wear.

INTEGRAL POSITION RETICLE

Measurement of exact positional change is fast and simple using the integral cross-hairs with numerical readout of X and Y coordinates. Enabled at the push of a switch, these cross-hairs may be quickly positioned over the subject of interest, and the frame-by-frame change in position accurately measured. Velocity, acceleration, growth rate, and a host of similar properties may be calculated using this handy feature instead of more expensive special-purpose film analysis equipment.

DATA-FRAME™ BORDER

The active image area of the SP2000 Motion Analysis System is surrounded with a border, providing a wealth of information which is recorded on the tape with the image. Included is a wide variety of parameters regarding the image captured on tape—an electronic log book recorded simultaneously with each frame. There are also messages indicating the source of the current image, the status of the recorder, and certain error signals such as a "NO-TAPE" signal when trying to record before loading a cassette. The SP2000 system not only helps prevent mistakes, it even tells you what's wrong.



THE SPLIT-FRAME MODE IS USED TO MULTIPLY THE EFFECTIVE RECORDING RATE. HERE, THE X3 BUTTON HAS BEEN ACTIVATED. EACH IMAGE IS TAKEN CONSECUTIVELY, SLIGHTLY AFTER THE ONE ABOVE IT.

EASY-TOUCH CONTROL PANEL

It takes only a few minutes to learn how to use the controls on the SP2000 system, which are grouped and color-coded by function. A high-reliability membrane touch panel gives protection against dust and liquids.

EASY-LOAD CASSETTE

The special SPI recording tape comes in easy-load cassettes, and changing is almost as fast and simple as for an audio cassette deck. This allows you to run a large number of tests without delay, subsequently examining each cassette for valuable information. Tapes may be stored for future reference or are easily erased for reuse.

DUAL CAMERAS

The SP2000 console will support two cameras, and the optional second camera may be used in a variety of ways. Simple push-button controls give you the choice of recording from either camera individually, or from both simultaneously in a wide variety of formats. You can even record stereo pairs for a unique high-speed analysis approach.

STANDARD VIDEO FORMAT

The video output of the SP2000 system is fully compatible with standard TV monitors and can be transferred directly by a single cable to standard Betamax, VHS, U-matic, and other video recorders. You can study your problem and find a solution, copy the images from the SP2000 system onto a standard cassette, and mail it to a colleague for review on a standard video cassette recorder. Hard-copy units designed for use with video output may be used to generate pictorial copies.

AUXILIARY DATA RECORDING

Additional data may be recorded on the tape of the SP2000 system simultaneously with the image through the use of a digital input port. When used with optional interface modules, the output of various instruments such as test transducers or range clocks may be stored in digital format to be read off the video screen upon slow motion playback.

A WORLD OF CONVENIENCE

DATA-FRAME BORDER—YOUR ELECTRONIC LOG BOOK

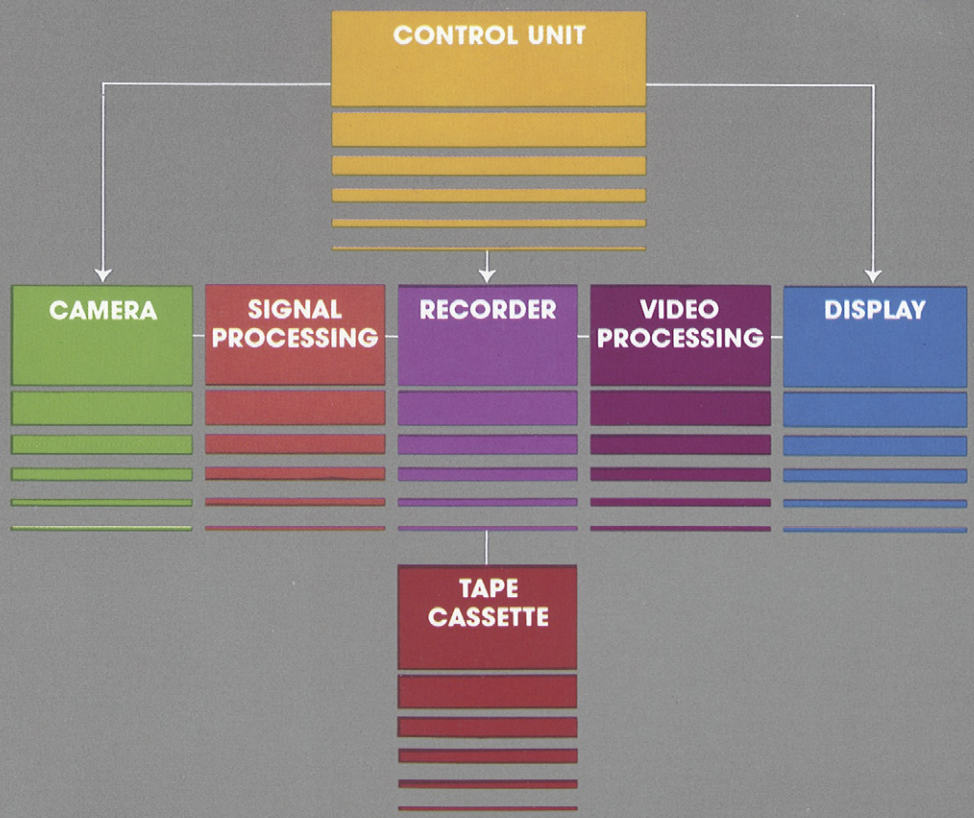
- **A** REAL TIME CLOCK WHICH REPORTS THE TIME OF DAY AND RECORDS IT ON TAPE.
- **B** TODAY'S DATE MAY BE ENTERED AND RECORDED WITH THE IMAGE TO AID IN TEST IDENTIFICATION.
- **C** ELAPSED TIME SINCE THE BEGINNING OF THE RECORDED TEST, TO 500 MICROSECOND PRECISION, UPDATED ON EACH FRAME.
- **D** USER-ENTERED, 4-DIGIT IDENTIFICATION NUMBER FOR UNIQUELY MARKING EACH TEST.
- **E** X AND Y COORDINATES OF THE CROSS-HAIRS POSITION, IF ACTIVATED. NOT RECORDED ON THE TAPE OF THE SP2000 SYSTEM, BUT IS TRANSFERRED TO THE IMAGE COPIED ONTO STANDARD VIDEO CASSETTES.
- **F** RECORDING RATE SELECTED.
- **G** FRAME COUNTER, WHICH INCREMENTS WITH EACH INDIVIDUAL FULL-FRAME PICTURE.
- **H** TAPE COUNTER, WHICH INDICATES APPROXIMATE POSITION OF TAPE IN THE TRANSPORT BY REPORTING THREE COUNTS PER FOOT OF TAPE. USED TO LOCATE SPECIFIC PRIOR RECORDINGS.
- **I** INSTRUMENT STATUS REPORT, SHOWING SUCH WARNINGS AS "NO CAMERA," "NO TAPE," OR "END OF TAPE."
- **J** IMAGE SOURCE REPORT, WHICH SHOWS IF AN IMAGE ON THE SCREEN COMES FROM A LIVE CAMERA, OFF TAPE, OR OUT OF THE BUFFER MEMORY.

CONTROL PANEL—EASY-TOUCH CONVENIENCE

- **K** DUAL CAMERA CONTROLS, ALLOWING FULL CHOICE OF IMAGING FROM BOTH CAMERAS.
- **L** SPLIT-FRAME FORMAT CONTROLS, PROVIDING CHOICE OF 1, 2, 3, OR 6 PICTURES PER FRAME.
- **M** X-Y RETICLE CONTROLS, FOR ACTIVATING AND MOVING THE CROSS-HAIRS.
- **N** PRE-EVENT AND POST-EVENT TRIGGER CONTROLS, FOR USE WITH EXTERNAL SWITCHING COMMAND TO AUTOMATICALLY CONTROL THE RECORDER START AND/OR STOP. REQUIRES OPTIONAL EVENT TRIGGER BOARD.
- **O** SLOW MOTION REPLAY CONTROLS, PROVIDING CONTINUOUS SLOW MOTION, AND *JOG-MODE* PLAYBACK IN 4 SPEEDS, PLUS FREEZE-FRAME IN BOTH FORWARD AND REVERSE.
- **P** RECORDER TRANSPORT CONTROLS, FOR FAST FORWARD, FAST REWIND, AUTOMATIC REPLAY AND STOP COMMANDS.
- **Q** RECORDING AND SETUP CONTROLS, FOR CHOICE OF RECORD SPEED AND LIVE CAMERA SETUP MODE.
- **R** NUMERICAL KEY-PAD, FOR ENTERING DATA AND PERFORMING DIAGNOSTICS.

CAMERA—SMALL AND POWERFUL

- **S** VIDEO SCREEN VIEWFINDER, ALLOWING CAMERA ADJUSTMENT REMOTE FROM THE CONSOLE.
- **T** REMOTE CONTROLS FOR RECORD, STOP, SETUP, AND REPLAY FUNCTIONS.
- **U** STANDARD C-MOUNT LENS.
- **V** STANDARD 1/4-20 TRIPOD MOUNT.



SPIN PHYSICS, INC., HEADQUARTERS, SAN DIEGO, CALIFORNIA. ENGINEERING AND MANUFACTURING FACILITIES FOR THE SYSTEMS DIVISION AND THE TAPE DIVISION ARE IN NEARBY SORRENTO VALLEY.

A WORLD OF TECHNOLOGY

THE CAMERA

Using a solid-state video sensor developed at Kodak Research Labs, the camera of the SP2000 system is a unique visual recording tool. The secret of its incredible framing rate is the ability to transfer 32 lines of photographic data in parallel at rates approaching 10^8 pixels per second. Unlike more conventional video-imaging tubes, the sensor of the SP2000 system exhibits no lag, thus ending forever the ghosting problem. And, it is not damaged by an overload of light.

SIGNAL PROCESSING

The data provided by the camera are converted to an FM-modulated signal, thus providing a well-known and understood recording technique for data storage. These data are fed in turn to the recorder with a special timing track to keep all the signals fully synchronized.

THE RECORDER

The SP2000 system is based on linear video-recording techniques. Patented Spin Physics microgap recording heads are used to achieve very high data packing density at very high data transfer rates not achievable with current rotating head designs. This allows recording of almost 10^8 pixels per second of data, at a density over 5×10^5 bits per square inch. The recorder transport mechanism is a precision data tape recorder, in a small package and designed for cassette loading. It reaches high operating speeds in minimal time, provides long recording times, and offers a wide variety of playback modes including continuous slow motion playback and freeze frame.

THE TAPE

Spin Physics, Inc., manufactures an outstanding recording tape jointly developed with Kodak Pathé. This tape exhibits a signal-to-noise ratio unmatched in the industry, and it provides a perfect match for the high-density recording required by the SP2000 system. Packaged in convenient cassettes, it may be stored for future viewing.

VIDEO PROCESSING

In playback, the parallel FM signals on tape are demodulated and then digitized for storage in a digital buffer memory, one TV frame at a time. This stored image is then fed in NTSC format to a standard television monitor. In freeze-frame playback, one frame may be stored and repetitively fed to the monitor from the buffer so that this image may be frozen on the screen indefinitely with the recorder stopped.

THE CONTROLS

6809 microprocessors are used to provide a wide range of simple, yet sophisticated controls. Firmware has been developed to allow operation of the system without extensive training, and includes safeguards which render the SP2000 system virtually immune to operator error. Diagnostic routines are included for troubleshooting many areas of system performance. Continuing firmware developments are expected to expand the application capabilities of the SP2000 system for years to come.

THE DISPLAY

The SP2000 Motion Analysis System incorporates a 12-inch diagonal monitor screen and further provides parallel outputs for a monitor or video tape recorder. The monitor retracts into the console for easy transport and storage, and is raised back into viewing position by an automatic gas spring.

A WORLD OF SUPPORT

SPIN PHYSICS, INC.

Established in 1968, Spin Physics quickly became a leading supplier of high-quality, high-performance magnetic heads for recording and playback of analog and video signals. Today SPI is the most respected name in the field, and has extensive experience in all phases of magnetic recording.

Purchased by Eastman Kodak Company in 1972, SPI is now part of Eastman Technology, Inc., and provides advanced electronics development capabilities.

TECHNICAL SUPPORT

Spin Physics, Inc., maintains a direct field force of technical representatives, thoroughly trained in the details of the SP2000 system. Application backup is provided through engineers who are conversant with your requirements and have the special knowledge to use the system to solve your problems. Our development engineering group is continually involved in system and application refinements to make certain that the latest in technical advances can be applied to your needs.

RELIABILITY/SERVICEABILITY

Each SP2000 system undergoes stringent performance and reliability testing before shipment. Dedicated computerized test equipment allows extensive tests to be made on each system following burn-in procedures. Solid-state design and extensive use of integrated circuits provides high reliability once the system has passed initial acceptance tests.

The SP2000 system has been designed with ease of service as a prime requisite. Self-diagnostics help to quickly locate system malfunctions. Most electronics problems can be solved at the board level, a procedure easily performed by users if they so desire. All printed-circuit boards contain numbered test points for troubleshooting and are easily accessible through the hinged card rack which allows one to work on the boards from the front of the console. Tape recorder components can be reached and serviced without extensive dismantling of the equipment.

SERVICE HOT LINE

Each user is given a Hot Line telephone number, which is manned during normal working hours by a service specialist who can help troubleshoot over the phone. During off hours, incoming calls are recorded for fast followup. This line may also be used for operation and application questions.

INSTALLATION AND TRAINING

A trained service representative installs each SP2000 system, performs acceptance tests, and trains the user in operation and operator maintenance procedures. Further formal training can also be provided to cover indepth servicing of the equipment, and in its use and application in a variety of sophisticated photographic settings.

FIELD SERVICE/SERVICE CONTRACTS

In addition to warranty service and emergency repair service, the Field Service Department also offers Service Contracts. Ask our Technical Representative for further details.

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