Control Developments

A Brief Introduction…

… dedicated to

- total control
- total solutions
- total quality

and

- ***total customer satisfaction!***

May 2003

Who are we...?

Control Developments was formed in 1987, with the aim of integrating electronics with real world hydraulic and pneumatic systems to find ***solutions*** to industry's measurement and control ***problems*.**

Since then our reputation for solving complex control problems has grown year by year and our customers now include the US and UK Armed Forces, Shell, AT&T, Ingersoll-Rand and many other household names.

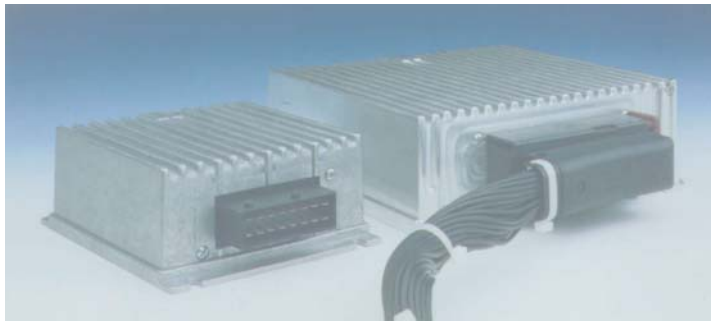
What do we do...?

Our areas of activity now include:-

- **Custom Solutions** - *to special sensing and control problems*
- **Standard Products** - *for measurement and electro-hydraulic control*
- **Software** - *for virtual instrumentation and control implementation*
- **Consultancy** - *on control theory and electronic systems*

Our capabilities have expanded to include:-

- hydraulic system design
- control stability analysis
- electronic circuit design
- complete system design
- special instruments
- CANbus nodes, displays and controllers
- CANbus systems with our partners Sensor-Technik



... right through to systems manufacturing and commissioning.

We believe we are among the top companies in our field in the UK and it is our aim to provide customers with the best possible solutions to their measurement and control problems.

We provide total control **solutions**…
....however large or small the **problem.**

CUSTOM SOLUTIONS - HYDRAULIC

The Problem

Our customer was building a sophisticated trailer for the US military which involved seven hydraulic axes, five of which were proportional. He needed a remote man-machine interface to enable all these axes to be controlled simultaneously. The equipment had to be very rugged, waterproof and easy to use. Above all it had to be totally reliable.

The Solution

We designed and built a chest pack that strapped to the soldier's waist and gave him excellent ergonomics and control by means of two dual-axis joysticks. Various buttons mounted on the chest pack enable different functions to be selected, and a cable connected the chest-pack to a vehicle mounted unit where the signals were distributed to the valves. The whole system was sealed to IP67 and passed United States Marine Corps 'first article testing'. Over three years, several hundred of these systems were sold to the USMC, and Control Developments now make it as a standard product for other remote control applications.

The Problem

A press powered by four cylinders required the cylinders to be moved in accurate synchronisation, and eventually to generate a controlled force versus time profile. The system had to be simple to operate and protected against a number of failure modes.

The Solution

We analysed the speed, accuracy and time response requirements and determined that for this application four proportional valves, each with a directional control valve would be perfectly adequate (thereby saving the customer the expense of using servo valves). The press was fitted with potentiometric sensors working on a rack-and-pinion principle, and arranged so that any sensor failure could be detected. An integrated controls package that synchronised all four cylinders was designed, with special attention paid to 'optimising' the control algorithm. We developed a controller based on a predictive-heuristic approach (i.e. it anticipated demand and learnt each time it operated to improve performance) and this formed the basis of the cylinder synchronisers that we now offer as a standard product.

The Problem

A manufacturer of turbine generators needed an electronic controller to take a Rolls-Royce jet turbine through a special start-up routine, following the correct speed-torque-time profile according to the phase of the start-up sequence, temperatures and pressures etc. The unit had to be fail-safe as possible, and had to be totally reliable as this turbine generator set was to be used on an offshore installation.

The Solution

In close consultation with the hydraulic start-pack manufacturer, we designed and manufactured a micro controlled closed loop speed-torque controller with a number of inputs for the various sensors (tachos, pressure etc.) in the system. The software was written to provide fast closed loop control, with various failure modes built in such as loss of power, loss of feedback signals, failure to disengage, over speed etc. Because the hydraulic pump was mounted a long way from the motor, transport delay times were taken into account in the software to minimise the tendency to hunt and to maximise stability margins.

This system has been in continuous use since 1992.

The Problem

Our customer needed to build a complete pipe handling system to deploy various types of pipe off the stern of a ship for the offshore industry. It was determined that five separate track drives (linear engines) would be used to cover all possible pipe configurations, and these would be driven by a large number of variable displacement pumps, proportional valves and on-off valves. A large number of sensors (approx. 30) were an integral part of the system to provide feedback information on pipe tension, clamping forces, speeds, pressures and inputs from up to seven operators.

The Solution

We designed and supplied a complete controls package that comprised a dual operator console fitted into a transportable cabin, with a multiple processor industrial computer network to process all the inputs and generate all the outputs including operator monitors. The software allowed single or dual operator control with a large amount of redundancy to ensure that the system could cope with

reasonable failures. All inputs and outputs were totally isolated, and five external control stations (see photo) were also provided for the remote control of pipe deployment when required.

The Problem

A refuse truck manufacturer wanted to build a one man operated vehicle for lifting and emptying 'wheely bins'. He had built a basic system using conventional relay logic and three proportional valves, but it was unreliable and extremely difficult to customise. It also relied on a number of expensive pressure switches and careful set-up and calibration before delivery to the final customer.

The Solution

We designed and built a powerful micro based controller that could interface to twenty solenoids, three proportional valves, a joystick and an operator panel including LCD display screen. Communication between the controller and operator panel and joystick was via a serial (multiplexed) link. This reduced interwiring drastically, and being micro-processor controlled meant a wide range of customisation was possible, The display showed status, errors, bin-count and weight and what was happening in a number of different languages, and the entire package was fully certified for safety by the German authorities. The electronics has self-diagnostics built in, so it can detect short or open circuit solenoids, and whether a pressure transducer is out of range, or a particular packing cycle took longer than it should have (hence indicating possible valve failures or leakages before they occurred). Our customer now uses only this version of electronics on all his one-man vehicles, and is in the process of converting his other vehicles (front and side-loaders) to the same system.

The Problem

A sweeper truck manufacturer was developing a new medium sized sweeper that was intended to be the most advanced of its kind in the world. It required an extremely sophisticated control system, but needed to be very reliable and easy to operate. The control functions needed to coordinate with the vehicle drive, and costs and wiring needed to be minimised.

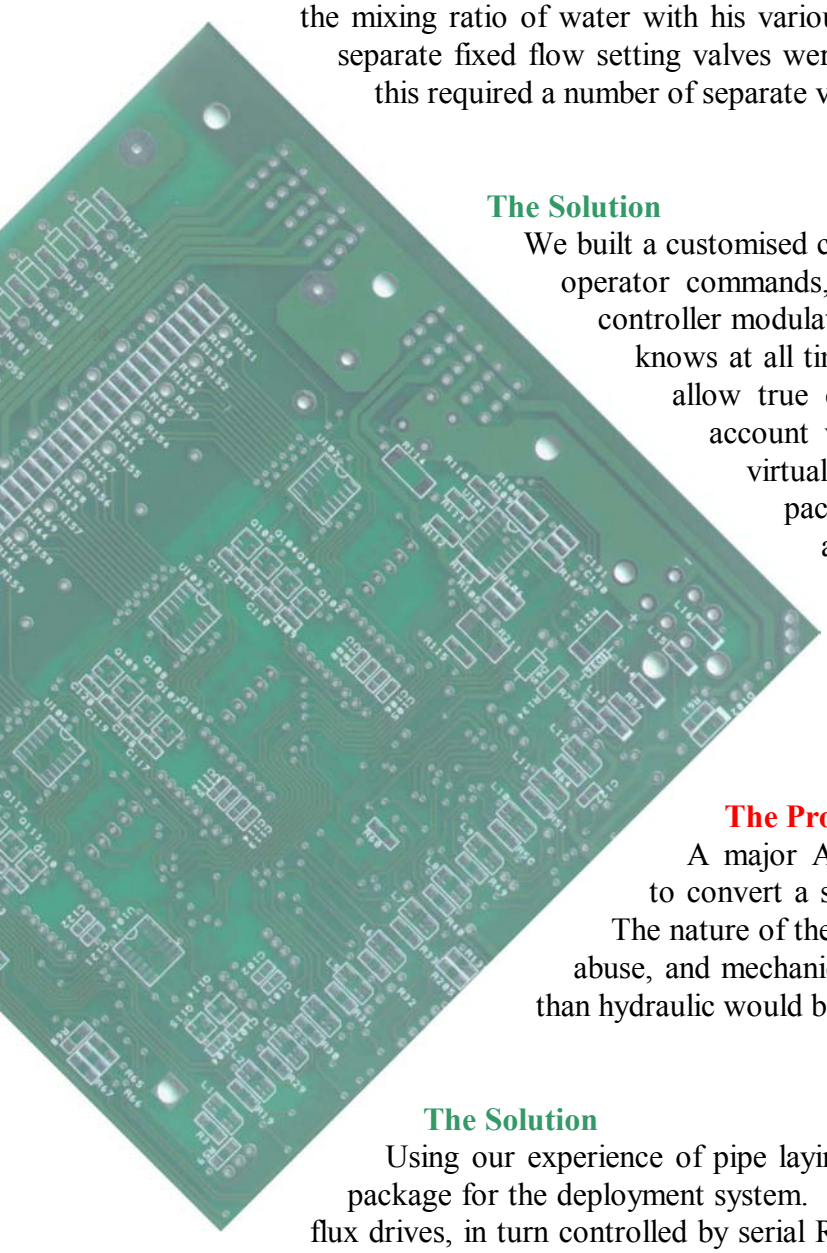
The Solution

We designed and built a CAN based controller system that was very cost effective, had minimal cable runs and full on-board diagnostics. It included two control nodes that were fitted to the exposed parts of the vehicle and were robust and very easy to configure. The system interfaced with a drive-by-wire controller that we also designed, and this gave the machine the ability to intelligently coordinate drive and sweep functions in an intuitive and time saving way. The master processor was fitted inside the cab, and had a user friendly display to show the status of any input or output, allow any output to be forced to any condition, and show any logged data or errors. It also had special software to assist the manufacturer during build (e.g. setting relief valves, calibrating wheel speed etc.).

OTHER CUSTOM SOLUTIONS

The Problem

A manufacturer of foam and water mixing equipment for fire appliances needed to be sure of the mixing ratio of water with his various foam concentrates. Previously a number of separate fixed flow setting valves were switched in, according to flow demands, but this required a number of separate valves and plumbing, and was not very accurate.



The Solution

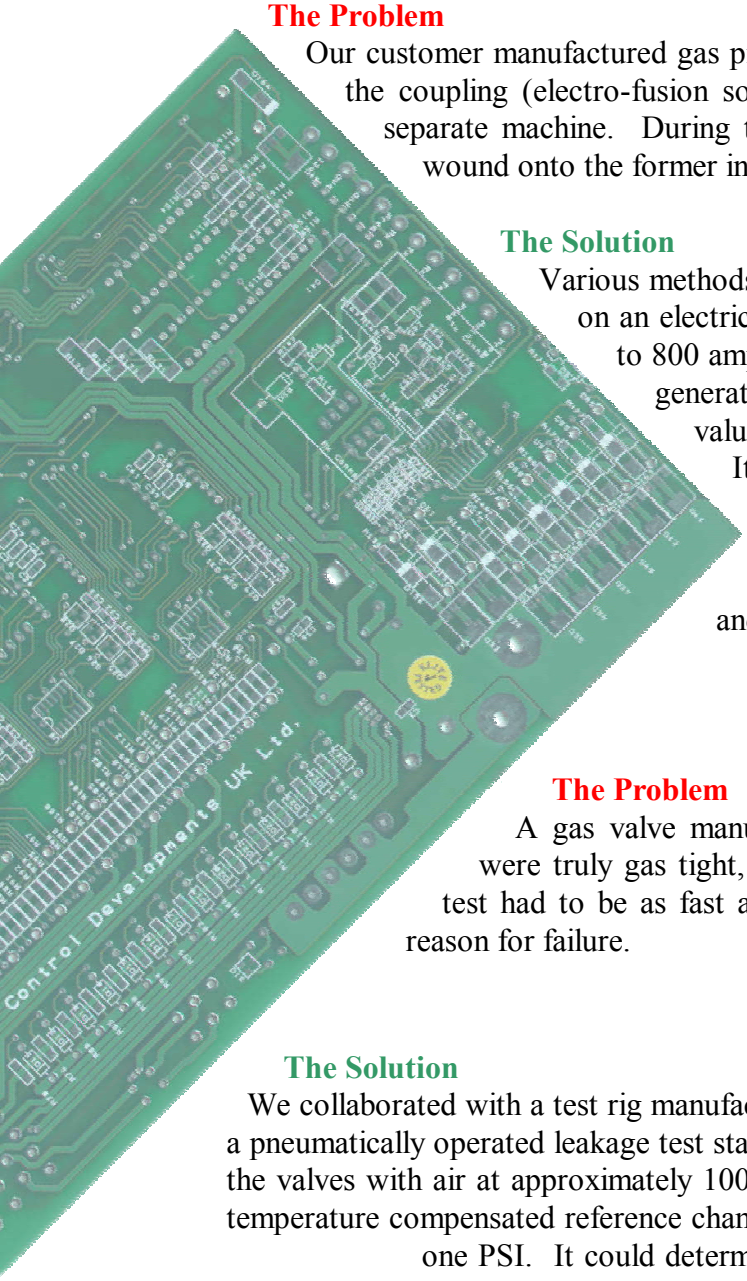
We built a customised controller to interface to all his flow sensors, the operator commands, and a variable process control valve. This controller modulates the control valve using a stepper motor, and knows at all times the angle setting of the valve. The sensors allow true closed loop ratio setting, and this takes into account viscosity and temperature variations, and also virtually removes the need for calibration. The package is also insensitive to power-supply losses as it 'freezes' in its last position as well as issuing alarms. This new system is being phased in and by the end of 1996 will have replaced the old system completely.

The Problem

A major American telecommunications company wanted to convert a ship to lay fibre-optic cable across the sea bed. The nature of the cable was such that it was sensitive to physical abuse, and mechanical restrictions meant that electric drives rather than hydraulic would be used.

The Solution

Using our experience of pipe laying systems, we designed the complete controls package for the deployment system. The linear engines were powered by AC vector flux drives, in turn controlled by serial RS485 links. The gripper tracks were controlled by servo hydraulic valves, and there were three such engines that had to be synchronised very precisely. Our control racks were robust, maintainable, and used standard architecture. The electronics was all enclosed in a cabin, and was supplied complete with battery back up and software, to handle all anticipated emergencies. Control Developments also provided a commissioning service until the customer was totally confident with its operation and performance.



The Problem

Our customer manufactured gas pipe fusion equipment in which the heating element for the coupling (electro-fusion socket) was a coil, which was heated externally by a separate machine. During the manufacture of this coupling, the coil had to be wound onto the former in a precise profile and at the correct temperature.

The Solution

Various methods of heating the wire were considered, but we decided on an electrical system whereby the wire was heated by passing up to 800 amps into it. We designed and built an ultra-high current generator that could have its current set from zero to full value, continuously with 0.5% accuracy and resolution. Its temperature was carefully monitored and synchronised with the stepper motor controlled winding mechanism. The entire system then interfaced to the customers robot handling system, and produces one coupling reliably every few minutes.

The Problem

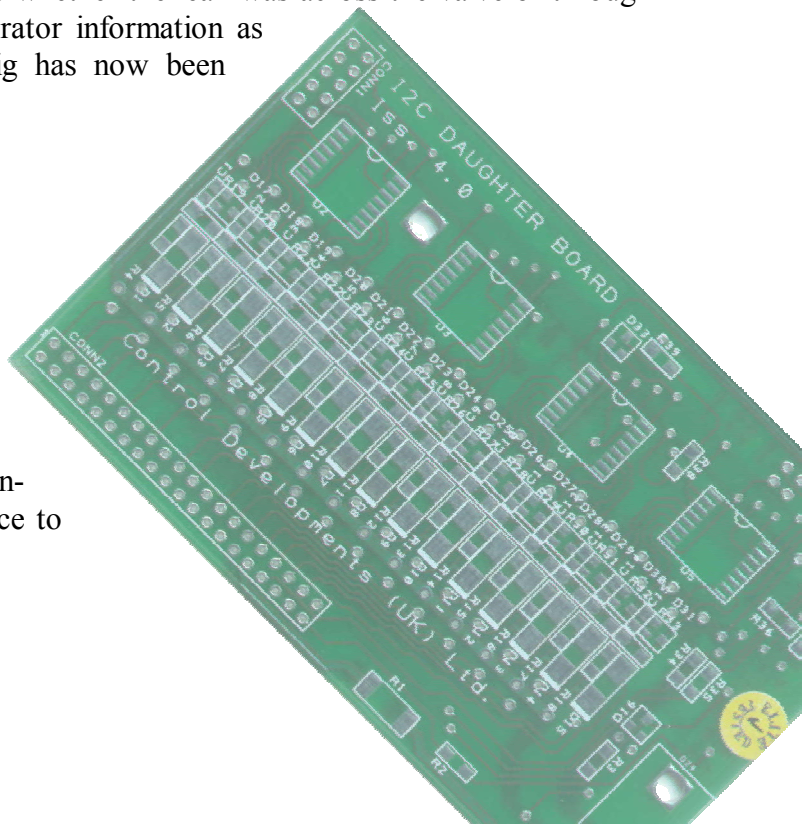
A gas valve manufacturer needed to test conclusively that his valves were truly gas tight, and the volume of valves produced meant that each test had to be as fast as possible, with a printout of the pass record or the reason for failure.

The Solution

We collaborated with a test rig manufacturer to provide the complete electronics package for a pneumatically operated leakage test station that tested two valves simultaneously. It charged the valves with air at approximately 100 psi, and by using differential pressure sensors with a temperature compensated reference chamber could detect pressure drops of one thousandth of one PSI. It could determine whether the leak was across the valve or through the spigot, and provided user-friendly operator information as well as the required print outs. This rig has now been operating continuously since 1988.

The Problem

A medical sensor manufacturer made glucose electrodes that could determine the concentration of certain ions in the blood by coming into contact with a blood sample from the patient. Each electrode needed 100% testing in a non-destructive way, but it was a difficult device to interface with.



The Solution

We designed and made a special 16 channel interface to measure the electro-chemical performance of 16 electrodes at the same time, the whole test taking less than thirty minutes. The interface had to have exceptional impedance and current sinking requirements, and by using special electrode guard ring methods and Teflon mounted circuitry, our instrument had an input impedance of more than one thousand giga-ohms, and a current bias of less than 200 femto-amps. By using auto-zero techniques an input offset voltage was achieved of a few micro-volts.

The Problem

An environmental sensor manufacturer identified the need for a hydrocarbon pollution sensor for use at oil storage sites. It had to be acceptable for this hazardous environment, and provide a means of alerting a central control, with minimal wiring and maximal flexibility.

The Solution

We developed the electronics for the sensor (based on Fibre Optic Chemical Sensors -FOCS) and a radio transmission system that enabled it to transmit data to a receiver. The receiver logged this data, and if necessary would contact a central station using a telephone modem and inform it of the hazard. At any point the system could be interrogated to establish trends, pollution levels, temperature and any other parameters that the operator programmed in.

The Problem

Our customer had a fleet of Hawker Hunter aircraft which needed a modern electronic package to control engine starting. The original starter was no longer practical and difficult to obtain. It was also very expensive (relying on explosive charges!).

The Solution

Using our previous expertise of starting turbines, we designed and built a custom electronic starter unit that took the turbine through the correct start up profile. It was small, lightweight and cost effective, and used modern solid-state technology which would provide much better control than was previously possible. It is now fitted to the Hunter as an option, and provides convenient, reliable and low cost engine starts.

The Problem

Our customer built a special purpose all-terrain vehicle, which is used by a number of armed forces, fire services and other organisations. The vehicle employed a commercial off-the-shelf engine and gear box which were controlled by a standard electronic module. However the torque and drive characteristics offered were not suitable for this vehicle given its application and working environment

Solution:

We designed a special interface unit that modified the performance characteristics of the engine-transmission train so as to have the desired drive. The microcontroller was self calibrating and programmed to work with he standard test electronics that would be normally used in diagnosing the transmission. It was especially important that the unit was ultrarobust, and we built an encapsulated high-reliability unit for this reason

STANDARD PRODUCTS

Over the years Control Developments have developed a number of products that, while initially 'special', have such wide-ranging applications that they now form part of our 'standard product' portfolio.

We therefore now manufacture a wide range of amplifiers for proportional and servo valves and pumps, a number of specialised joysticks, sensors and interfaces, and some control packages that are optimised for specific applications that occur very often in industry. These have all been tried and tested in the field, and we are confident that they are quite simply the best available - anywhere.

It is worth noting that **all Control Developments standard products offer features that cannot be found elsewhere**. Indeed it has been our policy to focus our attention on products that we believe cannot be sourced elsewhere – we do not simply provide 'more of the same'.

Many of our standard products are available with these additional specifications:

- **Ultra ruggedised** (for very harsh mechanical / chemical / EMI environments)
- **Expanded temperature range** (e.g. military)
- **IP65 / IP67 version**
- **Encapsulated**
- **High pressure immersible** (for sub-sea applications)
- **Marinised** (for marine deck-top applications)
- **Radiation hardened** (for nuclear applications)

Standard Products include…

Eurocard Amplifiers

ECA 1000

The Rolls Royce of all single channel proportional amplifiers, with precision high power voltage sources for external use, single ended and differential current, voltage and potentiometers inputs, ramps with direction indication, opto-isolated shut down, safety output limiting and many other features.

ECA 2000

A basic low-cost but very reliable, single channel proportional amplifier, with on board DC-DC converter for true negative rails, safety output limiting.

ECA 3000

A dual output proportional direction valve and over-centre pump controller without ramps but with all the features of the ECA 2000.

ECA 3500

A version of the ECA 3000 but with user programmable bi-directional ramps built in.

DIN Rail Amplifiers

MCA 2000

An ultra-flexible microprocessor controlled single/dual channel amplifier with enough flexibility to provide most common open and closed loop control functions for hydraulic proportional systems.

MCA 3000

A series of single channel amplifiers available with a range of "personality" boards to provide most useful control functions including PID controller, cylinder positioner, soft starter and many others.

MCA 4000

A true servo amplifier with user-adjustable gain, offset and dither, and incorporating a true negative rail for use with a single 12 volt or 24 volt supply.

Other Amplifiers

A small range of ‘Hirschmann plug’ type amplifiers for simple control from a voltage source or potentiometer, and DIN rail amplifiers for serial control over a two-wire multi-drop link.

Power Supplies

A wide range of DIN rail mounting power supplies to convert most common ac and dc inputs to the standard DC outputs.

Micro-Controllers

ESA 5000

A stand-alone Rurocard based processor equipped with a range of inputs and outputs that can handle the real world. These include two isolated analogue inputs, four isolated switch inputs, eight relay outputs and a high power analogue output.

It can interface to a keyboard, display screen and many expansion peripherals, and is ideal as an 'analogue input-output processor' in hydraulic applications. It forms the basis of many of our standard controller packages.

CANbus Systems

CAN 2000

A series of CAN based nodes and controllers that can be configured for J1939 or CAN2.0B format. They comprise a set of ultra-robust products which together can be made into an entire CAN network consisting of a large number of nodes and a huge amount of input/output. The units are intended to be very reliable and very cost-effective, and can be badge engineered to suit the customers own requirements. A full software and customisation service is also available.

Customised Standard Products include:-

Joysticks

A specialised series of control levers for applications that can not easily be satisfied by 'off the shelf' products. Examples include:

An IP67 joystick for a chest pack controller that could accidentally be immersed.

A 'stay-put' joystick with twist grip interlock to prevent accidental operation or travel from forward to reverse.

Special control handles with many functions built into the grip.

Sensors

We manufacture a range of low-cost position sensors based on an extending cable ('yo-yo sensors') that enable large stroke measurements in awkward physical situations.

Also in our portfolio is an intelligent pressure switch which uses a pressure transducer and microprocessor to respond intelligently to pressure variations in a system.

Ultra Eye IV is an ultrasonic ranging and head-of-material measurement and control system that operates a hydraulic pump or valve to maintain a level or position. It has full CAN J1939 compatible output, as well as analogue outputs for interfacing to other units.

The Sensor Processor. This is a micro based sensor acquisition system which processes up to eight analogue / digital inputs and generates an appropriate response. It can interface to strain gauges (i.e. pressure sensors, load cells etc.), directly and typical applications include safety overrides for crane out-riggers and anti-topple over-rides for fork lift trucks.

Controller Packages

We now offer mini-systems which are optimised for specific control functions. Examples are:

Four cylinder synchronisers using proportional or servo valves.

Cylinder position profiler.

Variable hydrostatic transmission speed - torque - power controller.

Generator constant frequency regulator using variable hydrostatic transmission.

Drive-by-wire control systems for full hydrostatic transmission control.

Track steering systems that control tracked vehicle speed and direction

Full CAN (J1939 and CAN 2.0B) control systems.

SOFTWARE

Many of the products and systems we manufacture require software, which is done in house by our own engineers.

The languages we use are Basic, Pascal, C (and C++), and various assemblers for use with embedded controllers.

Our expertise covers data acquisition and processing (input), computation and driving interfaces and peripherals (control), and data presentation (output).

Some examples are:

- Software to simultaneously measure the signals from a large number of strain gauges, provide noise and anti-aliasing filters, provide time phase compensation (for different sample times) as well as thermal compensation and linearisation, and output the results to an analogue port.

- Software to recover the data from a fast acquisition system reading the electromagnetic field strength in real time from a near field probe, and then provide spectral analysis of the data using FFT's to determine peak emission frequencies.

- Software to implement many different control algorithms, from trivial PID controllers to self tuning heuristic algorithms, including those using 'optimal control' theory.

- Software to control Automatic Test Equipment over the GPIB bus, and through RS232 / RS485 links.

- Software for the user friendly display of plant process status on an intuitive screen using process control icons. The operator could interrogate all sensors and activate all actuators in the plant very easily.

- Virtual instrumentation to provide a flexible display for a large number of sensors on a turbine test rig that would otherwise require a very large control/display panel.

- Software to enable a PC to extract data from a J1939 CANbus link, log it and put it in a spreadsheet presentable format.

CONSULTANCY

The Problem

An American automotive systems company was trying to develop an active suspension system for high performance cars, in collaboration with a British sports car manufacturer. Before spending large amounts of money on development, it was necessary to do a technical and financial feasibility study.

The Solution

We looked at the mathematical model that simulated the static and dynamic performance of a generalised car. We then studied the transfer functions describing a servo controlled hydraulic strut, and looked at how this could be incorporated into the mechanical model. The techniques employed involved a very clear understanding of a Laplace transform representation (for the servo hydraulics) and Lagrangian dynamics (for the car), and enabled the customer to evaluate the complexity of what was involved, the performance required of the valves and processor, and what the customer could realistically expect in terms of comfort, ride and handling.

The Problem

An MOD establishment that was responsible for testing most of Britain's military helicopter engines was using a number of test rigs that were now decades old, and consequently cumbersome and awkward to use. They identified the need for a modern, flexible and accurate system, but before commissioning it, required a realistic and achievable specification to enable its costing and build.

The Solution

Control developments spent a lot of time in learning precisely the operational requirements of the rig, and then used our extensive knowledge of fluid power controls, instrumentation and software to define a system specification that totally protected our customer. We built the computer control console for the test rig, provided all the software and the full calibration and commissioning service

Why should you use us...?

As a small specialist company we ensure that all our products are truly excellent, and our warranties underline this fact. We believe you share our values...

- **Safety**

The EEC has issued the Machinery Directive (89 /392/ EEC) and the Low Voltage Directive (73 / 23 / EEC) to ensure mechanical and electrical safety of equipment sold in the EEC. We are acutely aware of these during the design and manufacture of all our products, and for each of them we consider the various failure modes and possible consequences, and support our product with appropriate Technical Construction Files, or provide independent certification where required

- **Reliability**

We understand the high importance of reliability to industry. We use the best available components, and they are assembled meticulously.

- **Robustness**

We know the demands that industrial and mobile users put on equipment, and we make our products strong enough and tough enough not to let them down. Similarly our software doesn't "crash" just because the operator presses the wrong button! Our software is as robust as our hardware.

- **Ruggedness**

In the real world equipment has to withstand extremes of temperature, oil, water, dirt, and vibration. We don't expect anything else when we build equipment, so we normally use conformal coatings, high specification parts, locking nuts, and encapsulants.

- **Ease of Set-up**

You are entitled to expect the electronic equipment or software you buy to be like your hi-fi. It should simply plug in and go. We have designed our products so they can actually be used by our customers - not just by other electronics or software engineers.

- **Fail-safe**

Component failures can occur, but we design for the critical failures in particular, and do everything we can to ensure that failure results in a safe condition. All our closed loop controllers for example, have circuitry to detect loss of feedback signals and to initiate appropriate action.

- **EMC Compliance**

The EMC directive (89 / 336 /EEC) set out the requirements for the control of radiated and conducted emissions and immunity. To this end we maintain Technical Construction Files and where appropriate perform explicit tests to ensure compliance.

- **Long Life Span**

Although for contractual purposes our standard warranty is one year, in practice we expect all our hardware products to last many times longer than this. We offer full continuing support for all our products.

- **Ergonomics**

When our equipment has a user interface, (e.g. joysticks, control panels, display screens etc.) we endeavour to make it as comfortable, natural and intuitive as possible. Where software is used, we make it user friendly as well as robust.

- **Excellence in Performance**

As measurement and control experts we know what quantitative criteria are important in an application. All our products have specifications that are both well defined and exceptionally good. In addition our closed loop controllers enable near optimal control that is usually limited only by the mechanical capabilities of the customer's system.

- **Service & Support**

In a word BACKUP. As far as we're concerned, once you've bought one of our products you will receive technical support indefinitely - not from an importer or distributor who may not actually understand the product, - but from the original designer.

- **Suitability**

Before we sell any of our hardware or software, we talk to your engineers to ensure it will perform the task to your complete satisfaction.

- **Documentation**

Each of our products is documented in a manual that details operational schematic, set-up, calibration, specifications and basic tests. In certain cases complete maintenance documentation and circuit diagrams are also included.

- **Quality**

We have a very comprehensive Quality Manual that defines all our procedures precisely, and are now working to ISO 9002.

IN CONCLUSION

The pages you have just read give you an overview of some of the activities that Control Developments is expert in - but a few pages cannot describe all our capabilities.

Here are some final comments for you to consider:

- WE ARE **EXPERTS** from the mathematics of control theory to the practical realities of hydraulics - we know our subject intimately.
- WE ARE **ENTHUSIASTIC** we do what we love, and we love what we do. This means you can expect and will receive total commitment from us.
- WE ARE **PERFECTIONISTS** We strive for excellence and accept nothing less.
- WE ARE **COMPETITIVE** We win repeat business by giving performance and value for money.
- **WE WANT YOUR BUSINESS** at Control Developments we still believe the customer comes first and we will do whatever is necessary to meet your commitments, to exceed your expectations, and to provide your satisfaction.

CONTROL DEVELOPMENTS...

TOTAL CONTROL

TOTAL SOLUTIONS

TOTAL QUALITY