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Trio's MC206X provides stabilised control for 30 metre film and TV camera positioning mast.

- Design brief for portable, battery powered giant mast required more than the average amount of ingenuity

Tewkesbury - UK - November 2008: Trio Motion Technology's MC206X motion controller is being used to provide position and stability control for a 30 metre camera mast that provides sweeping high-angle aerial shots for film and TV. The Vortex Aerial Mount Camera System, developed by professional cameraman Matthew Gladstone of Cammotion with the help of automation specialist Machinery Control Systems (MCS), is completely portable and can be rigged and de-rigged in minutes - making it suitable for a wide range of spectacular shots for outside broadcast and film studio work.



Building a camera mast that extends as high as a twelve storey building with the dynamic stability to support a full-sized 50 kg camera at speeds of 2 metres per second in potential Force 7 winds is no mean feat! To make the challenge even harder, the brief included stowing and operating the mast from a single-axel trailer that needed to include self contained operation from batteries to enable its use at Lynx golf courses and other sporting events that prohibit noisy generators and towing from vehicles that may damage the ground.

The most impressive part of the Vortex is the design of the mast itself and the MCS developed motion control system that uses many advanced features of the MC206X to both smoothly position the mast and provide the high stability control required during filming. The seven section mast is constructed using lightweight carbon fibre for maximum stiffness-to-weight ratio, with each section rigidly interconnected through linear bearings with a large surface contact area to minimise deflection. A central Kevlar cable runs through each section on an internal pulley system using a servomotor driven geared winch that first moves the mast from its horizontally stowed position to its vertical operational position - and then axially separates each mast section to lift the camera platform up or down during filming.



Stabilisation control is taken care of with four Kevlar guy ropes that are fixed at the top of the mast near the camera platform and are controlled from servomotor driven geared

winches bolted to outriggers on the trailer. The guy ropes are independently tensioned in tight synchronisation with each other and with the main mast winch and camera position. MCS needed to carry out extensive development work to prove the tension control system. Initially, they tried torque control on each guy rope but that resulted in actually adding unwanted deflection to the mast under strong wind conditions where unequal forces on the mast resulted in excessive torque demand as the control system tried to correct the 'error' on the leeward side.

The solution was to use the MC206X in position control mode with the effective length of each guy rope precisely maintained relative to the height of the mast as it travels up or down, or remains in a static position. In this mode, the wind force on each side of the mast may vary, but a combination of tensioned guy ropes with exactly the same length will always maintain the optimal mast stiffness without adding deflection.

In addition to the synchronised control of the four guy ropes and the central mast, critical forces on several mast-mounted load cells are monitored through the MC206X's digital and analogue inputs with multitasking TrioBASIC software ensuring that the stabilisation control is performed within predetermined load tolerances for the mast structure. The high speed of the MC206X easily provides the necessary performance even under gusty wind conditions, with a dynamic following error that translates to no more than +/- 4 mm over 30 metres travel at maximum traversing speeds.

To meet the requirements for self powering the trailer and from battery operation, all components needed to be as energy efficient as possible. Vortex has hydraulic motors fitted to each wheel that are independently controlled to drive and manoeuvre its 3400 kg payload. The four outriggers used to level the trailer and house the guy rope winches are also hydraulically powered. The hydraulic power packs include variable speed drives for the pumps.

The choice of servomotors and drives also included the ability for dynamic braking so any energy generated in the guy rope winch motors is injected back into the batteries as the mast is extends. The Vortex will also run from a 240 V, 13 A supply for film studio work.

The MC206X is also used for the Vortex's hand-held joystick controller as well as assorted analogue and digital I/O functions which are interlocked in logic to ensure safe operation. Tim Oxtoby, Managing Director of MCS, a long term Trio Motion customer, designed the control system which required much more than the average amount of ingenuity. Oxtoby said "The decision to use battery power had a major influence on the design and choice of components of the electrical and control system." He added "We used a mix of variable speed and servo motors and used a 220V, 3 phase supply to maintain the power required. We also wanted to control the hydraulics from the same source so the flexibility the MC206X offered as an independent motion control product made it a great choice to effectively manage all this different kit in a seamless way."

As the hydraulics and servo motors are not used at the same time, MCS was able to switch the control to each system, saving costs by using just one MC206X with an optional daughter board for 5 axes of servo control. The servo drives selected can also be reconfigured as open-loop, flux vector, or variable speed drives allowing multiple use that keeps the control straightforward, and saves hardware cost.

The MC206X is aimed at small to medium sized motion and machine control applications in manufacture and test, process control, and research. Its high performance 32-bit floating point DSP technology provides high-speed, flexibility and connectivity for up to 4 axes of

stepper or servo motor control plus a master encoder input and two virtual axes. An expansion connector is also included for an optional fifth servo axis module or a daughter board to enable digital drive networks such as Sercos, Control Techniques SLM or CAN to be used to add additional axis control, increase I/O or provide an interface for factory communications.

The controller is part of Trio's Motion Coordinator family that offers motion and machine control from 1 to 64 axes in modular designs that allow machine builders and OEMs to select their preferred drive, feedback and motor technologies in combination with a wide choice of factory and drive communication networks. The range includes the scaleable MotionPerfect2 application development language with its easy-to-use and powerful multitasking TrioBASIC software or a choice of G-code or IEC 61131 programming options. A number of progressive features are included to ensure reduced application development times, increased production throughput, improved accuracy and higher levels of security for automation systems of all sizes.

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High resolution image download and text available from Tactical MarComms - www.tacticalmarcomms.com under downloads for Trio Motion

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