A320: fly-by-wire airliner
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itched 30° nose-up, flying at 300ft
and a mere 95kt, the Airbus banks
25° and begins a gentle climbing
spiral. Why is this particular A300
performing a manoeuvre no other airliner could safely attempt—and how?
"We are demonstrating the low-airspeed handling qualities expected of the fly-by-wire A320," says Airbus Industrie engineering test pilot Gordon Corps. To do this, Airbus has programmed one of the A300's autopilot computers with A320 control laws, and has installed A320 side-stick controllers for both pilot and copilot. When the 150-seat A320 enters service early in 1988, it will be the world's first fly-by-wire airliner. Of the many advances incorporated in this all-new aircraft, it is the electronic flight control system that attracts most attention.

All of the A320's flight control surfaces are electrically, rather than mechanically signalled: except, that is, the rudder and reversionary control of the trimmable tail-plane. Fly-by-wire was chosen because it saves weight through the large reduction in mechanical parts—rods, cables, pulleys, and bellcranks—which also means a reduction in maintenance.

Perhaps the greatest benefit, at least for the pilots, is the improvement in handling qualities. Airbus likens flying the fly-by-wire A320 to driving a stagecoach. Where

"The A320 lives in a box—it

can't fly too slow; it can't fly too fast." So says Airbus about its new 150-seat, fly-by-wire airliner. Graham Warwick

reports from Toulouse.

the coach driver gives a command and the horses take care of the road, the A320 pilot makes a control input and the aircraft takes care of the flightpath. Having been educated in all the permissible speeds, attitudes, and manoeuvres, the A320 will never overspeed, overload, or stall, Airbus claims.

The Airbus objective in designing the A320's control laws was to improve handling and reduce pilot workload. Auto-matic pitch trimming endows the aircraft with apparently neutral longitudinal static stability—"the aircraft stays where you put it," says Corps. In fact the aircraft is positively stable, and the elevator is working continuously to make it appear neutrally stable, but the pilot is unaware of this.

"The aircraft has to be statically stable, otherwise it would be positively unflyable," says Corps. "But static

stability can be fatal because it produces heavy stick forces, for example in wind-shear."

Originally developed by Nasa, the A320's C* pitch control law is a g control law with pitch-rate feedback. In effect, the pilot's sidestick becomes a "trajectory con-troller". Stick movement commands a change in flightpath with a certain level of g for the manoeuvre. If the pilot releases the stick, the aircraft will hold its new trajectory until the stick is moved again. If no pilot input whatsoever is made, the aircraft will maintain a logical track and altitude.

Pitch-rate feedback is required, says Corps, because g feedback is not good enough at low speed. Pitch-rate feedback is fed in progressively below 200kt until, at 150kt and below, the two feedbacks have equal effect. A320 pitch control also provides automatic elevator to compen-sate turns up to 33° bank—"You just roll the aircraft, establish alpha [angle of attack], and leave it alone," says Corps. A320 lateral control allows the pilot to demand roll rates up to 25°/sec, although the aircraft is capable of much higher
rates, which are used to counter uncom-
manded disturbances. Lateral attitude
hold is provided in turns up to 33° bank,
above which the aircraft has positive
spiral stability that brings it back within

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