bring a substantial gain in optimizing the operation of an adaptive optics system, particularly important for the VLT prospect. ADONIS continues to rely on the collaborative action with ONERA and Laserdot which made the success of its predecessors. The continuing adaptive optics development programme is currently the only one which is solely dedicated for nighttime astronomy and which has produced significant astrophysical results.

Nonlinearity Problems with Generation-3 CCD Controllers

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Introduction

At present, there are 20 CCDs from five manufacturers running under three different control systems in use at La Silla. Recently, during an observing run at the 2.2-m telescope, a nonlinearity in the response of CCD #8 was discovered (Remy et al., 1992). This short article is intended to describe the problem, set limits on its first possible occurrence, inform the reader about its solution and request contacts from interested parties.

The Problem

During the observing run of 27.2.1992 to 1.3.1992 at the 2.2-m telescope with EFOSC2, with observers Surdej et al. for Key Programme 2-003-43K, a nonlinearity in the CCD response was found. The effect shows up as a feature in the plot of signal variance versus mean signal (the transfer curve, Janesick et al., 1987). For a properly functioning system this plot should be a straight line in the photon shot noise dominated regime whose slope is the inverse of the system conversion factor in electrons per ADU. Figure 1 shows the nonlinear behaviour. A similar feature is also present in the linearity curve for the CCD (mean counts versus integration time), with a total excursion from linearity of 4 % peak-to-peak.

Investigation of the problem revealed that the fault was with the analogue to digital converter board in the Gen3 system, not the CCDs themselves. These boards replaced the previous model boards because of their lower noise performance. Replacing the new boards with the old cured the problem. Figure 2 shows the same plot as Figure 1, but after installing the old boards which have all been in place since 6.4.1992. Since the old boards were originally replaced in 1986, we must also determine when the nonlinearity first appeared and which CCDs were affected.

Which Systems Have Been Affected?

Only instruments using Gen3 systems have been affected. There were 4 such

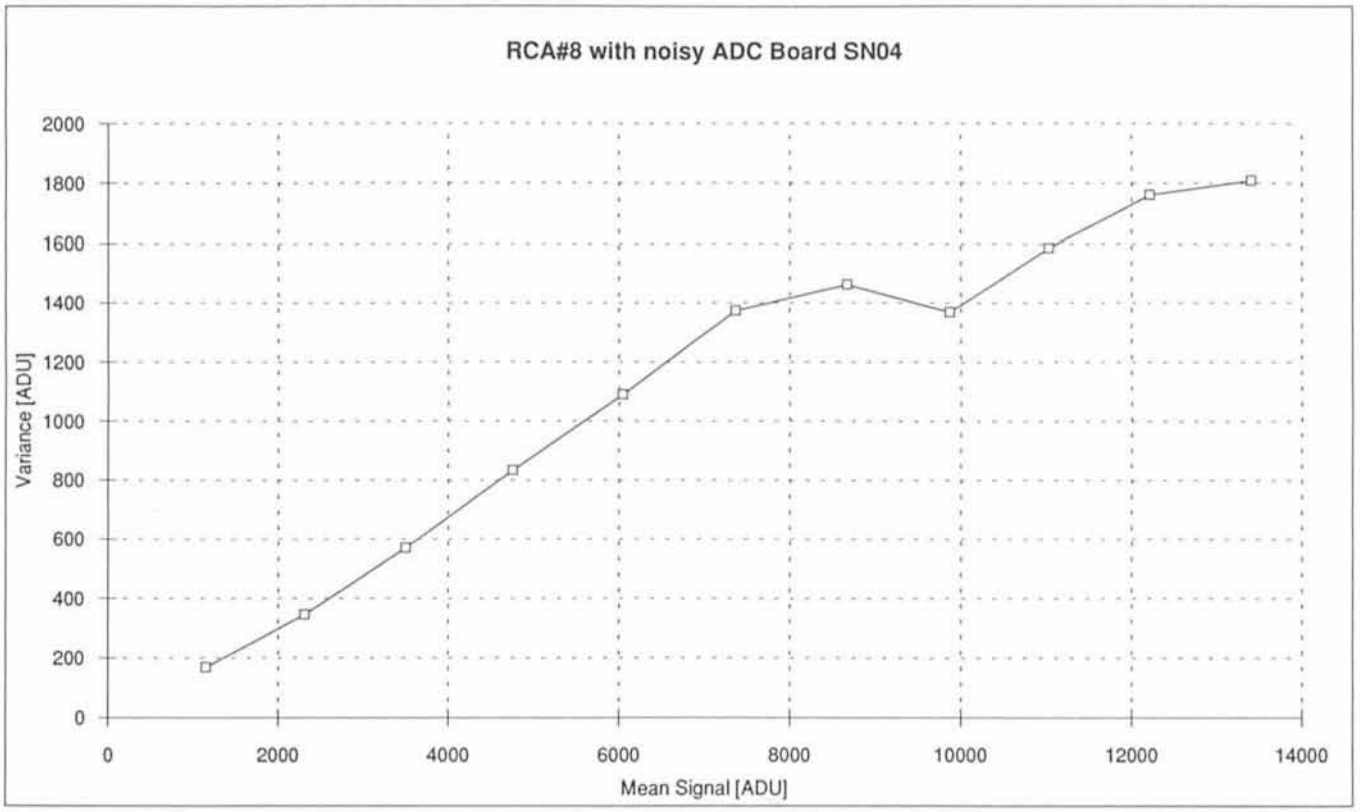

Figure 1.

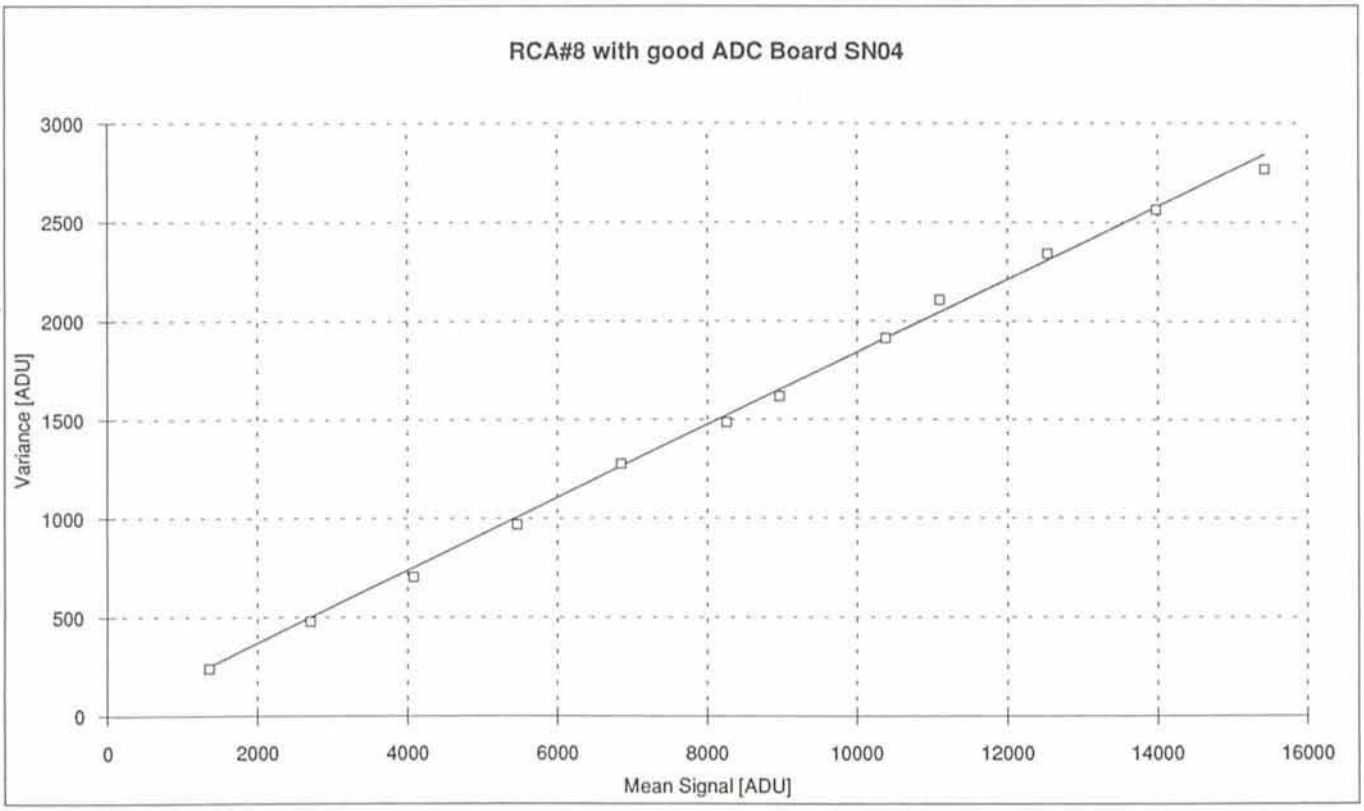

Figure 2.

sets of CCD electronics in use at La Silla:
(a) 2.2-m with adapter, EFOSC2 and Boller and Chivens. CCD used: #8
(b) 1.54-m Danish with adapter. CCDs used: #5, 15.
(c) 1.52-m with Boller and Chivens and Echelec. CCD used: #13.
(d) 0.91-m Dutch, since July 1991. CCDs: #14 (briefly in July 1991), #7.

Note that none of the Gen5 or VME systems have been affected by the problem at any time. Therefore data from Ford, Thomson and Tektronix CCDs have not been affected.

When Did the Problem First Occur?

To determine the first occurrence of the nonlinearity, data have been analysed at La Silla. The earliest known affected data were taken on the 1.54-m Danish telescope in February 1991 with CCD #15 – the effect is only marginally present. Data from 1988, 1989, and 1990 are being investigated.

What was the Nature of the Problem?

It has been found that there is an extra noise component present in the system which contributes in the range 6,000 to 10,000 ADU, just the range in which the nonlinearity occurred (Fig. 1). This measurement was made using a CCD video simulator which produces a signal with noise independent of the signal level, unlike astronomical signals where the noise varies with the square root of the signal level (shot noise). For the old (good) boards the result was a variance which was constant with signal level; the new (bad) boards showed the additional noise component. It is therefore clear that the excess noise component is linked to the observed nonlinearity.

After solving the main problem, further investigations have revealed that there are still low-level nonlinearities present which are still being studied.

Further Information

For further information, please contact the authors (hschwarz@eso.org and tabbott@eso.org) and watch *The Messenger* for further articles concerning CCDs at La Silla.

References

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CASPEC Improvements

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Introduction

CASPEC, the high-resolution spectrograph mounted at the Cassegrain Focus of the 3.6-m telescope, has been the object of almost constant upgrading in the last three years (Pasquini et al. 1991, 1992).

CASPEC is the only high-resolution spectrograph at La Silla which offers a broad range of options: a rather high resolving power coupled with a large spectral coverage, the possibility to easily change the central wavelength and the capability to observe in the blue and UV up to the atmospheric cut off (Baade and Crane 1990, Molaro et al. 1992). These characteristics, coupled with the large telescope aperture, have made of CASPEC a powerful and versatile instrument used by a large number of observers.

During 1992 CASPEC was not