The good agreement exists in spite of the large distance between the two monitors (several kilometres), the factor 10 difference between their sample duty cycles and their independent designs. Periods of rapidly fluctuating seeing were generally excluded from the samples used in this comparison, to avoid possible local effects.

While this result is encouraging and allows a good deal of confidence in RoboDIMM's seeing measurements, it is not conclusive, since no median below 0.6 arc seconds was used. Calibration of RoboDIMM is ongoing, including characterisation of intrinsic errors and comparison with other seeing monitors such as NAOMI's Wave Front Sensor.

As regards hardware components, ING's RoboDIMM bears a close resemblance to the CTIO's automatic seeing monitor (which, incidentally, is also called RoboDIMM, but the originality of that name is disputable! See `www.ctio.noao.edu/telescopes//dimm/dimm.html`). There is an important difference in that the CTIO's takes samples alternating between 5 and 10 ms exposure time. This forms two samples from which the image motion at "zero seconds exposure" is extrapolated, following the method established by ESO in its Chilean seeing monitors. The zero-second seeing may reportedly be 10–20% larger than the 10 ms estimate (A. Tokovinin, 2002, *PASP*, **114**, 1156), depending on the speed and altitude of turbulent layers. When comparing results from different sites, it is important to bear instrumental differences in mind but we should also remember that the strength of the exposure time "blurring" effect may differ greatly between sites, as well as vary over time.

Conclusion

With the commissioning of the RoboDIMM seeing monitor, ING has provided its Adaptive Optics programme with an important auxiliary instrument. It provides a seeing FWHM estimate at regular intervals that can be relied upon to within about 10% in stable conditions. RoboDIMM allows NAOMI performance to be monitored in real time, and also provides essential information for AO observing in queue mode. Additionally RoboDIMM provides all telescopes on site with data that can help astronomers to optimally adjust telescope and instrument focus. It allows them to make sure they are fully availing of the superb natural seeing available at the Observatorio del Roque de los Muchachos.¤

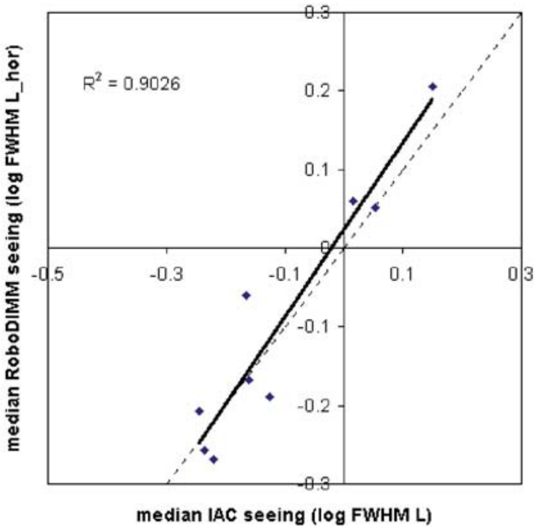

Figure 3. A scatter plot of the seeing FWHM measured by the IAC DIMM as a function of simultaneous RoboDIMM seeing. The best fit line, close to y=x, and the large correlation coefficient (0.91) illustrate the close dependence of these two variables. Each of the 9 points represents the median seeing from simultaneous samples formed by a continuous period of stable seeing lasting several hours. The logarithmic scale is necessary to convert seeing FWHM into an approximately normally distributed variable.

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CONCAM — ING's All-Sky Camera

René Rutten (ING)

It has been a long-standing wish at the observatory to have a night-time all-sky cloud monitor. A cloud monitor, in the first place, allows astronomers in the control room to assess the actual situation of the night sky without the need of having to rush out for a visual check. The latter usually requires rushing up and down stairs, standing in the cold outside, and waiting for the eyes to get adapted to the dark, and even then one would only have a partial snapshot of the situation in the sky.

The ideal cloud monitor works at infrared wavelengths where the contrast between the cloudless night sky and the relatively warm clouds is high. However, a suitable infrared camera is rather complex and expensive to build, and as the equipment has to be located outside, there is a significant maintenance overhead as well. To avoid these problems we have been looking for an alternative for some time and came across CONCAM.

CONCAM stands for CONtinuous CAMera, designed and built by Robert Nemiroff and his team at Michigan Technical University. It is a well designed and built, self-contained system that only requires connecting to electrical power and the internet. CONCAM consists of a fish-eye lens that projects the night sky onto an SBIG CCD camera. The camera itself is controlled by a small notebook PC. The full system sits in a small, well-sealed weather tight box, located on the roof of the liquid nitrogen plant building, close to the junction of the road leading up to the WHT.

The camera switches itself on during evening twilight and stops at the end of the night. Images are taken every couple of minutes, and exposure times are up to a few minutes during moonless periods. Data is automatically transferred to Michigan, and immediately bias corrected and flat fielded. The reduced data and nightly movies are then made available on the web through the on-line CONCAM archive at Michigan (see `www.concam.net`). Copies of the reduced (and compressed) nightly movies are archived locally on La Palma and available at `catserver.ing.iac.es/weather//archive/index.php` (follow the link to the archive and select the required day).

Currently, CONCAM systems are installed not only on La Palma, but also at Mauna Kea, Kitt Peak, Mt Wilson, Wise Observatory (Israel), Rosemary Hill (Florida), South Africa and Siding Spring.

The initiative leading to the development of CONCAM was centred around the idea of monitoring the brightness of relatively bright objects and to permanently look for bright transient events across the whole sky. Besides these primary goals, CONCAM also offers very good possibilities for stimulating public interest, as the sequence of CONCAM images very clearly demonstrate how the sky varies during nights. CONCAM images can show a number of interesting atmospheric and night-sky features. CONCAM shows of course the position of planets and the moon, but also shows the zodiacal light, it announces sunrise and sunset, and even makes visible the patterns in the OH night sky lines. An excellent set of examples of what CONCAM sees is shown at `www.concam.net/phenomena.html`. For ING, however, the main role it serves is that of all-sky cloud monitor.

The all-sky movies that are automatically generated give a very good visual impression of transparency variations across the sky, and how it varies in time. Clouds can be seen rolling in, allowing the astronomer to take advantage of the best parts of the sky and plan the observing programme. Together with the weather maps, the meteorology data, and the robotic seeing measurements, ING now possesses a comprehensive set of tools for planning observations and assessing post-observing data quality.

We are very grateful for the superb collaboration and assistance received from the team at Michigan Technical University, in particular from Robert Nemiroff and David Crook.¤

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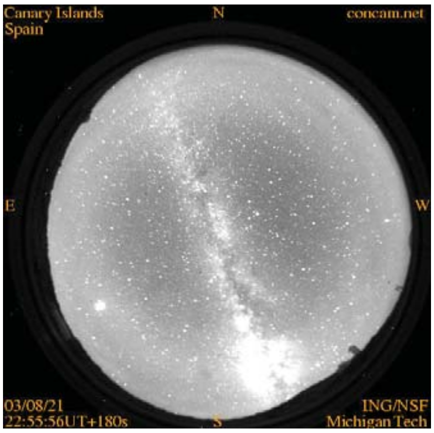

Top left: CONCAM on the roof of the liquid nitrogen plant. Top right: A closer view of CONCAM. Above: CONCAM image of the Palmeran night sky.

L3 CCD Technology

Simon Tulloch (ING)

Low Light Level (L3) CCD technology is a recent development from E2V that opens up interesting new observational regimes. The technology allows production of scientific CCDs in which the read noise of the on-chip amplifier becomes negligibly low. Additionally, this effective zero-noise performance is decoupled from readout speeds and the almost zero noise performance holds up to frame rates of 1 KHz. E2V achieve this by using an avalanche multiplication mechanism in the horizontal register of the CCD. A single photo-electron entering this register exits as a substantial charge packet; the exact gain being variable and determined by the level of a high voltage multiplication clock. At gain levels of around 500 it becomes possible to identify individual photon events in the image. The downside of L3 technology is that the multiplication process degrades the SNR at higher signals by a factor of $\sqrt{2}$. There is also a small additional noise contribution from spuriously generated electrons within the device.

L3 CCDs should be useful in any observing regime currently limited by detector noise. Wavefront sensing is an obvious application and E2V have produced the 128×128 pixel frame transfer CCD60 with this in mind. We have purchased one of these and are currently working on an upgrade to the Naomi WFS. Figure 1 shows the kind of gains we can expect once this system is commissioned. For comparison, the performance of Naomi's current WFS, the CCD39, is also shown.

Other applications for L3 technology are currently being evaluated on the WHT using a cryogenic test camera in which we have mounted the CCD60 (see Figure 2).

This camera was mounted on the Auxiliary port in November where we tested its performance as a fast photometer. On the 10th we observed