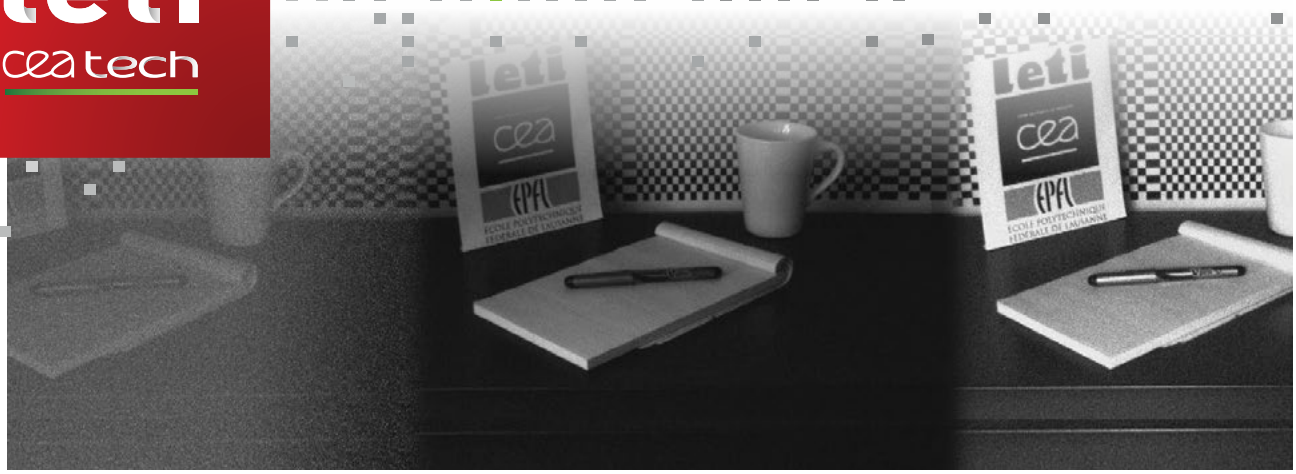


OWLY-EYED

SUB-ELECTRON READOUT NOISE FOR LOW LIGHT IMAGING

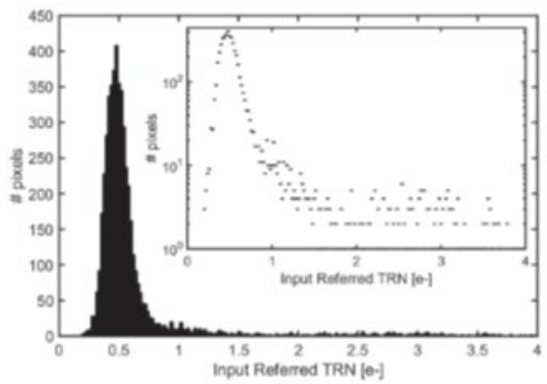
WHAT IS OWLY-EYED?

A sub-0.5 e− rms temporal read noise VGA (640H×480V) CMOS image sensor has been integrated in a standard 0.18 µm 4PM CMOS process. The low noise performance is achieved exclusively through circuit optimization without any process refinements. The presented imager relies on a 4T pixel of 6.5 µm pitch with a properly sized and biased thin oxide PMOS source follower.

Process	180 nm CIS
Active array size	640(H)×480(V)
Pixel size [μm^2]	6.5×6.5
Fill factor [%]	40
Conversion gain [$\mu V/e^-$]	160
Full well capacity [e^-]	6400
Column-level gain	×1 ×64
Pixel readout time [μs]	25
Read noise (peak) [e^-_{rms}]	0.48 @ room $T°$
Dark current [e^-/s]	5.6 @ room $T°$
PRNU [%]	0.77
Imager lag [%]	0.1

APPLICATIONS

Today, markets like medical, security, industrial vision, defence, scientific imaging or space are expected to grow and increase the demand for more sensitive CIS operating in low light conditions.



WHAT'S NEW?

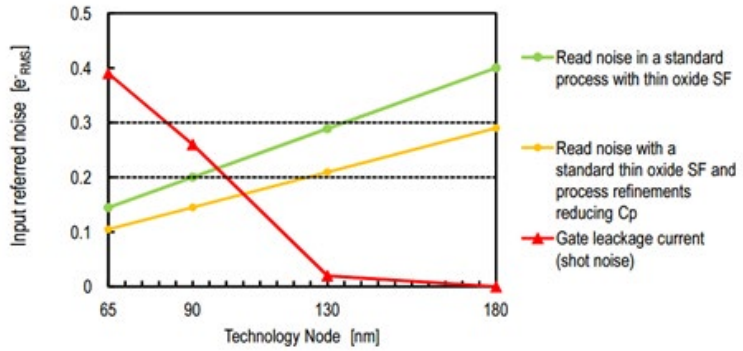
A new circuit optimization technique to further reduce the TRN in a standard CIS technology (without any process refinements) is used. A detailed noise analysis of a classical CIS readout chain shows that the input referred 1/f noise can be reduced using three techniques that can be combined with each other. The first one consists in the reduction of the transistor 1/f noise process parameter (K factor). The second one is by minimizing the contribution of all parasitic capacitances to the sense node, including overlap, wiring and junctions capacitance (Cp, Ce). The third technique consists in optimally sizing the in-pixel source follower (SF) transistor by using a minimum gate width (W), an optimum gate length (L) and the best available oxide thickness (Cox) [2].

$$\overline{Q_{n,1/f}^2} = a_{CMS}\frac{K\left(C_P + 2C_e \cdot W + \frac{2}{3}C_{ox} \cdot W \cdot L\right)^2}{C_{ox}^2 \cdot W \cdot L}$$

The first and second approaches have often been addressed using exclusively process modifications. In this work, we apply the third technique by making only design choices (W, L and Cox).

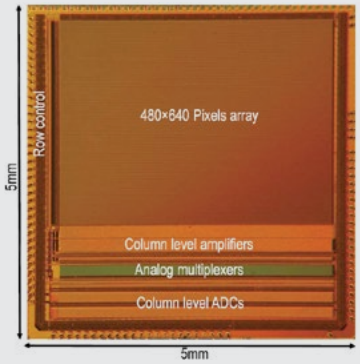
WHAT'S NEXT?

Besides the read noise originating from the 1/ f and thermal noise, the gate leakage current shot noise has been up to now neglected due to the extremely low levels of the leakage currents achieved in the used technology. The Figure below also shows how the input-referred noise is expected to decrease by only taking advantage of the technology downscaling.



KEY FACTS:

- papier JSSCC
- papier Sensors
- papier IISW



INTERESTED IN THIS TECHNOLOGY?

Contact:
Nom Prénom
mail@cea.fr
+33 tél