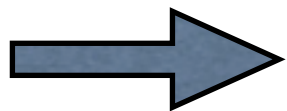


Some proposed algorithms for VSWG

Laurent Eyer (Observatoire de Genève)
Cambridge, April 15 2004

Goal of the talk

- To reach agreement on some algorithms for the GDAAS2 deadline of September 2004

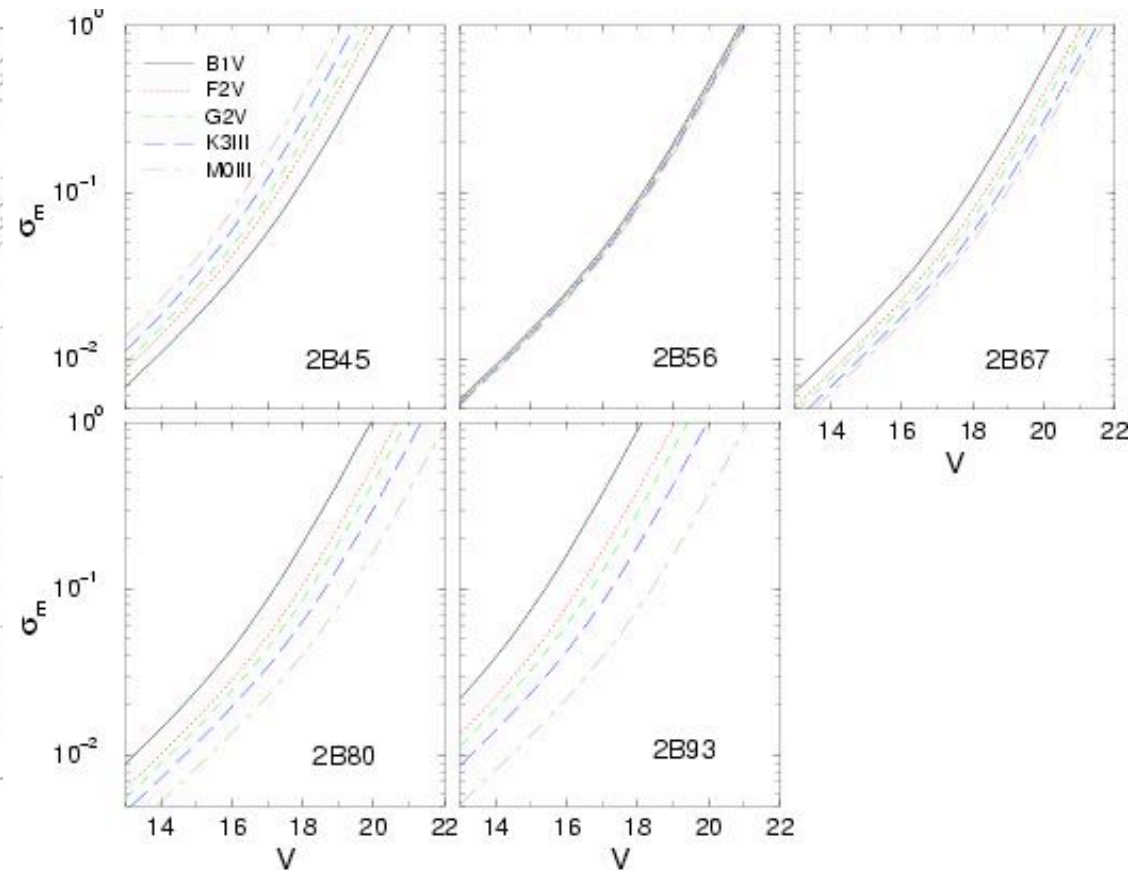
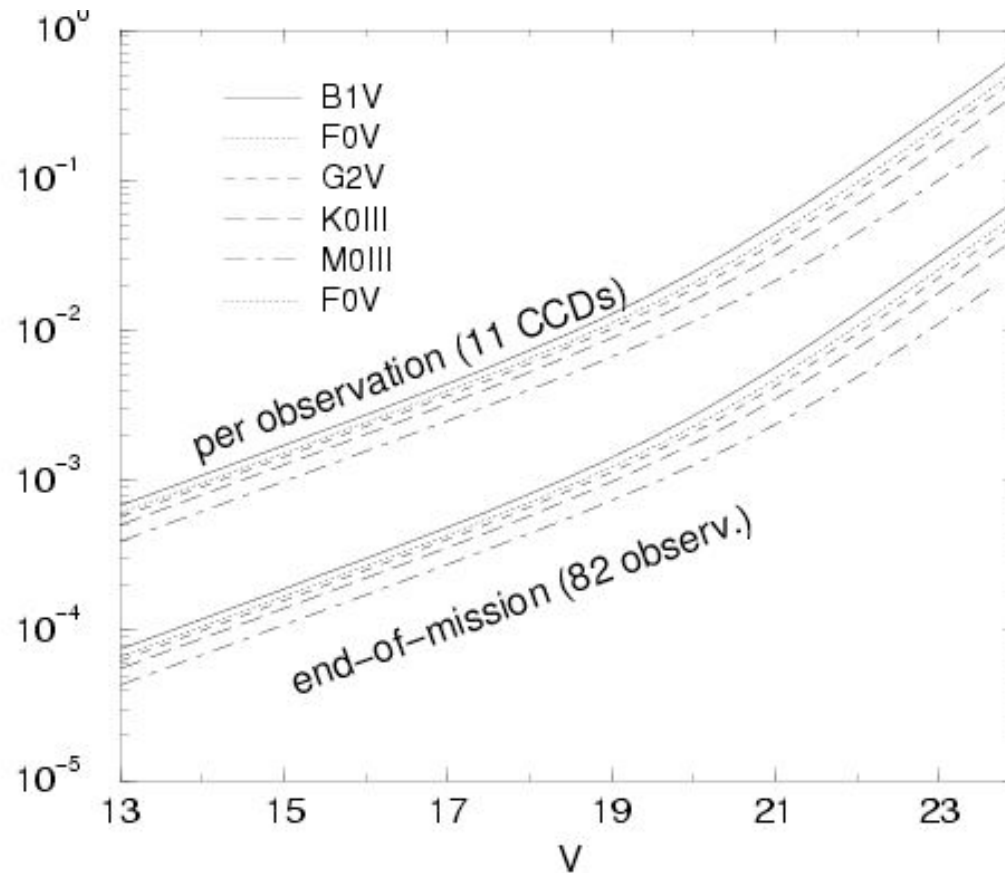


People can write and test algorithms

Structure of the work

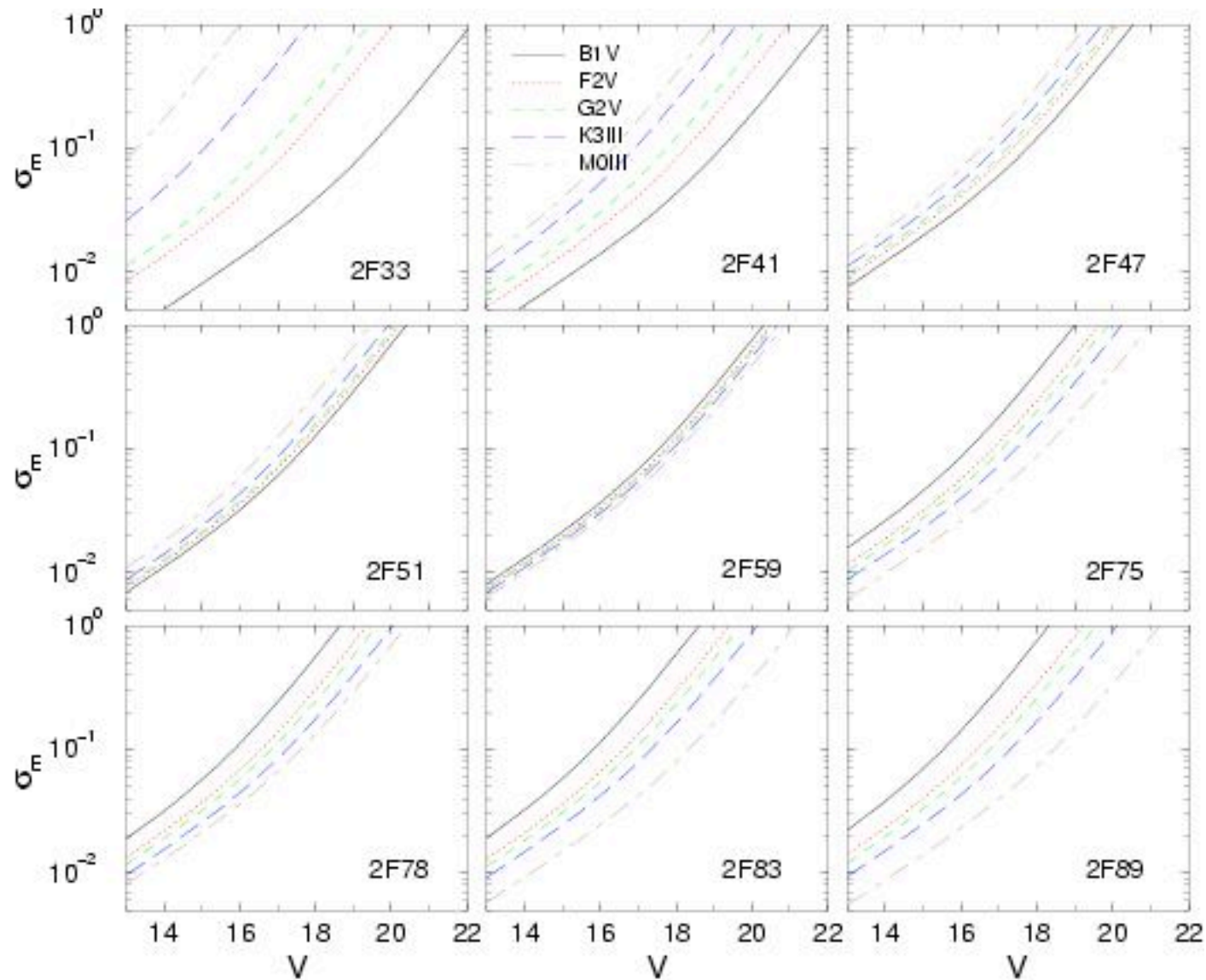
- To detect variability
 - To determine time scales
 - To search for periods, to model
 - To define parameters
 - To classify or to extract
- } This meeting

Reminder: G, BBP photometric per-transit precision



A mean number of 82 transits over 5 years

Reminder: MBP photometric per-transit precision

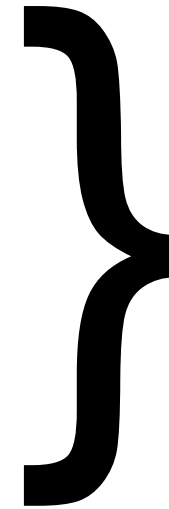


a mean number of 200 transits over 5 years

Proposition I: Variability detection: like in Hipparcos case

- In Geneva group:
 - Series of parameters, hypothesis testing:
 - Moments (1st - 4th)
 - Outliers
 - Abbe test
 - Trend

or
Robust
Versions



Proposition I

 Determine Statistics of the tests (simulations)
Evaluate critical regions

Size of critical region (p-values)

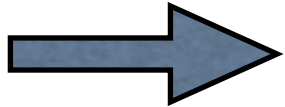
Different number of measurements

Different precision

p-values permit to **compare**, and **select** stars

a) **“well behaved” stars**

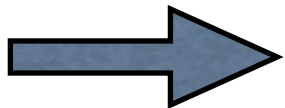
b) **Variable stars**



False detections

10^9 objects, test at 1 per thousand

one million false detections



What test on what data ?

- “Per CCD” ? (Anthony Brown)
- Per transit analysis ?
- What filters, how to combine filters?

Proposition II:

Covariance Matrix

- To compute the matrix of covariance (diagonalisation) of filter data (5 for BBP)
- Enhance variability detection capability
- Use for Classification:
 - To plot components of the eigen vector with highest eigen value)

Proposition III:

Variogramme/Structure function

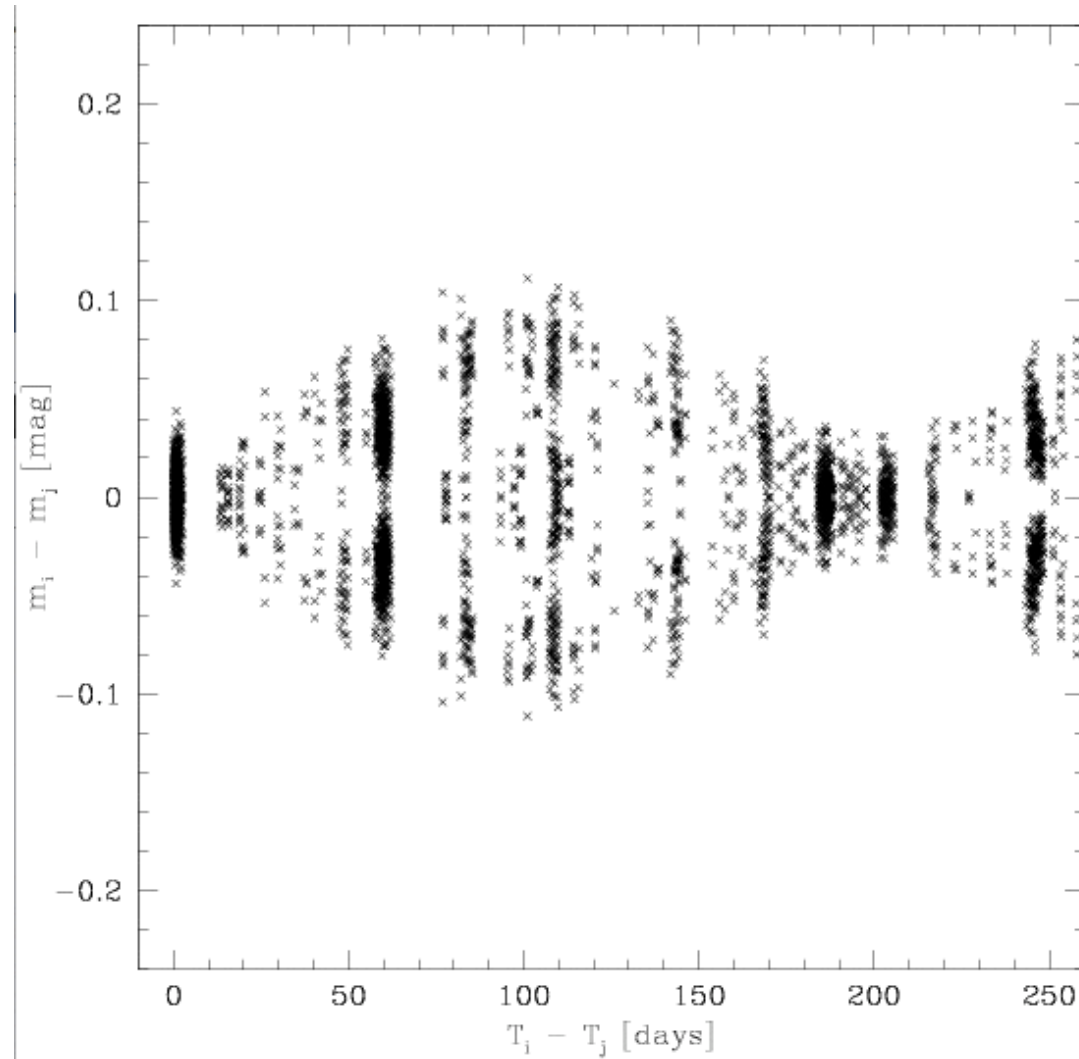
- Signal: $m(t)$, with a deterministic component $\mu(t)$

$$E(m(t)) = \mu(t), \quad \forall t \in D,$$
$$\text{Var}(m(t+h) - m(t)) = 2\gamma(h)$$

- Estimate noise (if no short time scale)
- Permit to determine range of time-scale $\text{Var}(m(t+h)-m(t))$ versus $\text{Var}(m(t))$

See simulation (movie)

Periodic (200 days) Sinusoidal Signal where we grow the amplitude

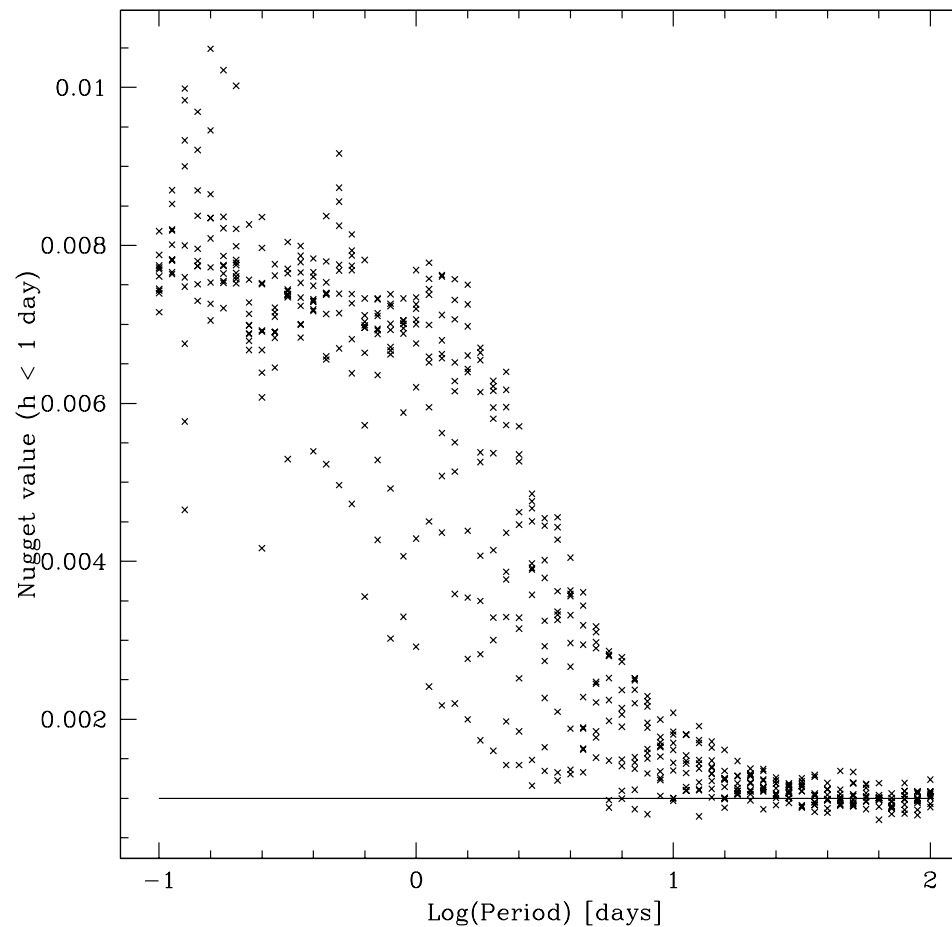


Simple method: Two outputs

- 1) $\text{Var}(m(t+h)-m(t))$ for h small (error)
- 2) If $\text{Var}(m(t))$ large (small errors)
- compare to $\text{Var}(m(t+h)-m(t))$ for h small
 - if similar \longrightarrow **short time scale**
 - if not \longrightarrow can set a **limit** on period (period search algorithm)

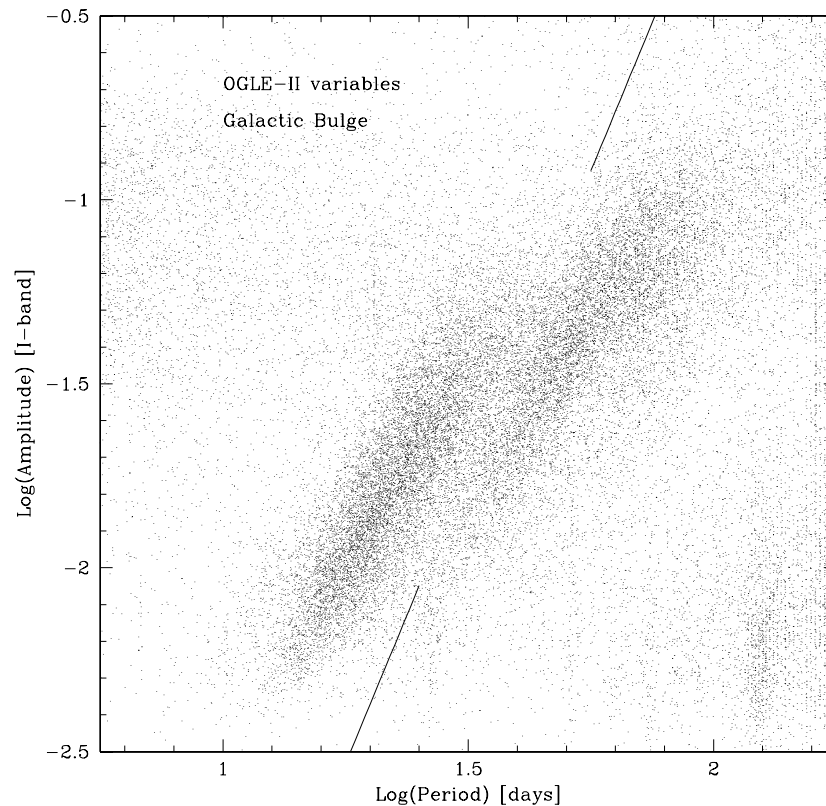
Example

- 10 “Gaia” stars randomly chosen
- signal to noise ratio of 10



Straightforward Application

- Mira, SR, SARV stars
 - many 100'000 variable stars !



OSARGs of Wray, Eyer & Paczynski 2004

OGLE-II Bulge fields:
11 square deg
15'000 red giants

Conclusion:

Who wants to work, participate?

- Laurent with Dafydd?: Tests/Covariant matrix/Variogramme
- Annie? Bayesian approach, with?
- ?
- See (soon) on the web-site the list of tasks