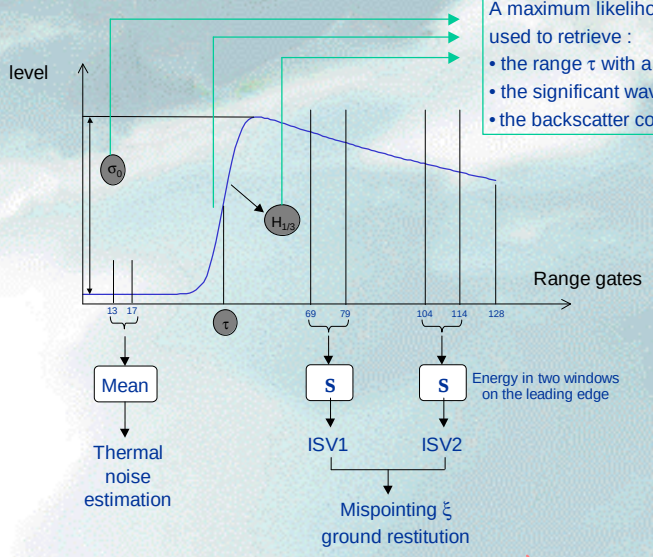
The on-board fine estimator algorithm

A maximum likelihood estimator (MLE) is used to retrieve :
- the range τ with a centimetric precision
- the significant waveheight $H_{1/3}$
- the backscatter coefficient σ_0



MLE principle :

The aim is to fit the return waveform with a mathematical model, the Brown 's model.
After a few approximations, this is equivalent to solve the iterative equation

$$\tilde{\theta}_{n+1} = \tilde{\theta}_n - k\left[BB^T\right]^{-1}BD$$

$\tilde{\theta}_n = [\tau, H_{1/3}, \sigma_0]$ — To be estimated parameters for the n[th] iteration

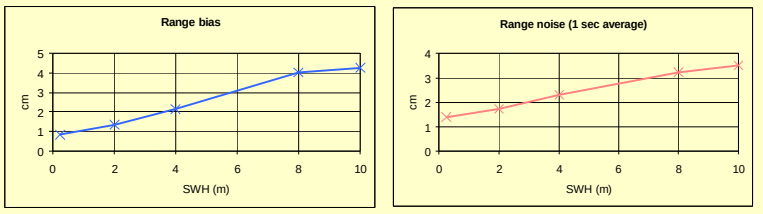
Estimator gain (on-board value : 0.5)

$B_{mk} = \frac{1}{\overline{V_k}} \frac{\partial \overline{V_k}}{\partial \theta_m}$ $\begin{cases} m = 1,...,M \\ k = 1,...,K \end{cases}$ — Matrix defined by partial derivatives of the Brown 's model

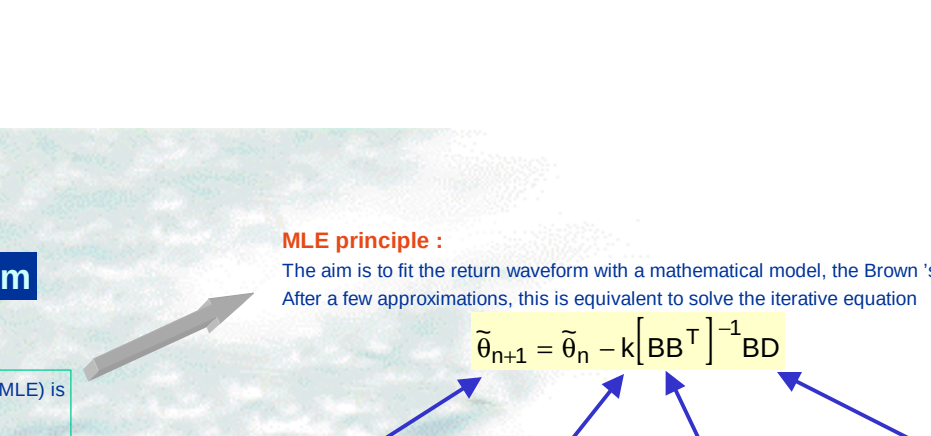
$D_k = \frac{\overline{V_k} - V_k}{\overline{V_k}}$ $k = 1,...,K$ — Error between the signal and the model

The on-board MLE is a simplified algorithm :
- Partial derivatives are quantified as a function of H1/3 (step : 25 cm)
- These functions are written in on-board tables
- Mispointing impacts will be corrected in the ground processing

Examples of simulated altimeter Ku range measurements : bias and standard deviation issued of 600 s simulations plotted versus SWH.



Poseidon 2 design



Relationship of waveform and telemetry samples

Waveform sample number	Telemetry sample number (Ku-band)
13 … 17 17…71 72…96 97…116	1 2…50 51…56 57…60

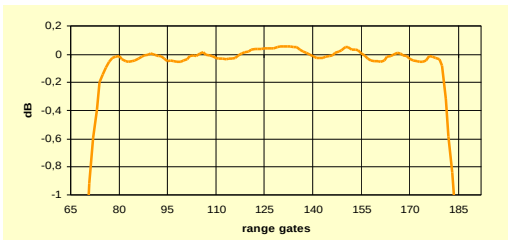
In a Ku/C320 configuration, telemetry samples in Ku-band are averages of five range gates on the pre leading edge and on the trailing edge. Parameters can be changed by command.

⟹ **Data rate is about 22 kbits/sec**

The CAL-2 mode

Principle :

This mode is designed to measure the altimeter transfer function for each frequency band by analysing the thermal noise in the reception channel over a long periode. It can be operated either in both frequencies simultaneously or in Ku-band only.
Altimeter analysis windows have to be positioned to a range that guarantees the absence of returned echos.
In particular, through this processing, filters profiles can be measured.



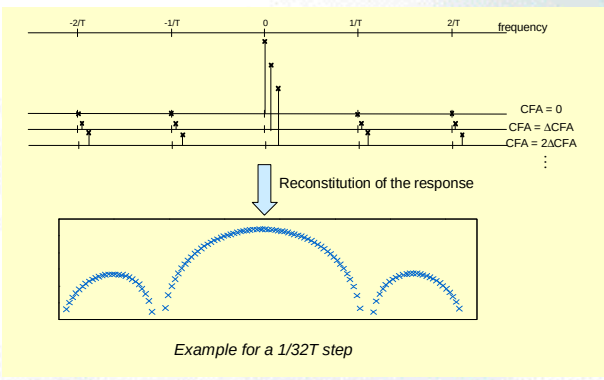
FI2 and FIR combined profiles

System requirements for the altimeter

The CAL-1 mode

Principle :

This processing mode gives the altimeter point target response (complex spectrum), either in Ku- or C-band.
The transmission channel of each band is looped back to the corresponding receiver input through the calibration attenuator.
In order to obtain a high resolution for this response, the central frequency of the spectrum analyser can be scanned by CFA multiple step (ΔCFA). This step is specified in the command.
ΔCFA can either be 1/64, 1/32 or 1/16 range gate.



Example for a 1/32T step

Some requirements for real time on-board product

Noise : standard deviation issued of 1 sec averaged data	**Range noise versus SWH**				**Significant waveheight noise**	**Sigma naught noise**
	SWH = 2 m	SWH = 4 m	SWH = 6 m	SWH = 8 m		
Ku-band	**2.1 cm**	**3.1 cm**	**3.8 cm**	**4.4 cm**	50 cm or 10 % of SWH	0.7 dB
Combined **Ku + C**	**2.5 cm**	**3.8 cm**	**4.6 cm**	**5.4 cm**