

EXT & FFS Orbit Feedback

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Overview

- Orbit feedbacks in EXT and FFS desirable to auto-correct for both any internal slow drifts and any slow drifts in DR extracted beam.
- Keep beam within measurement range of IPBSM (drift $\sim < 100\text{nm}$ vertically at IP).
- Works with incoming 1.56Hz beam rate, can only correct noise sources $\sim < 0.75\text{Hz}$.
- Preliminary tests of an EXT+FFS feedback implemented in FS shown here.

Orbit Feedback

- Choose correctors and BPMs with good sample of available phases in EXT & FFS
- 3 horizontal correctors
 - ZH1X; ZH10; ZH1FF
- 4 vertical correctors
 - ZV1X; ZV2X; ZV11X; ZV1FF
- 6 BPMs (x & y)
 - MQD2X; MQF4X; MQF9X; MQM16FF; MS6FF; MFB2FF

Feedback Algorithm

- $B = R * C$

$R = [\text{len}(B) * \text{len}(C)]$ (response matrix)

$B = [B_x \ B_y] \ C = [C_i]$

- Use Matlab `lsqcov` to form solution to weighted least-squares solution \rightarrow corrector solution (***err***)

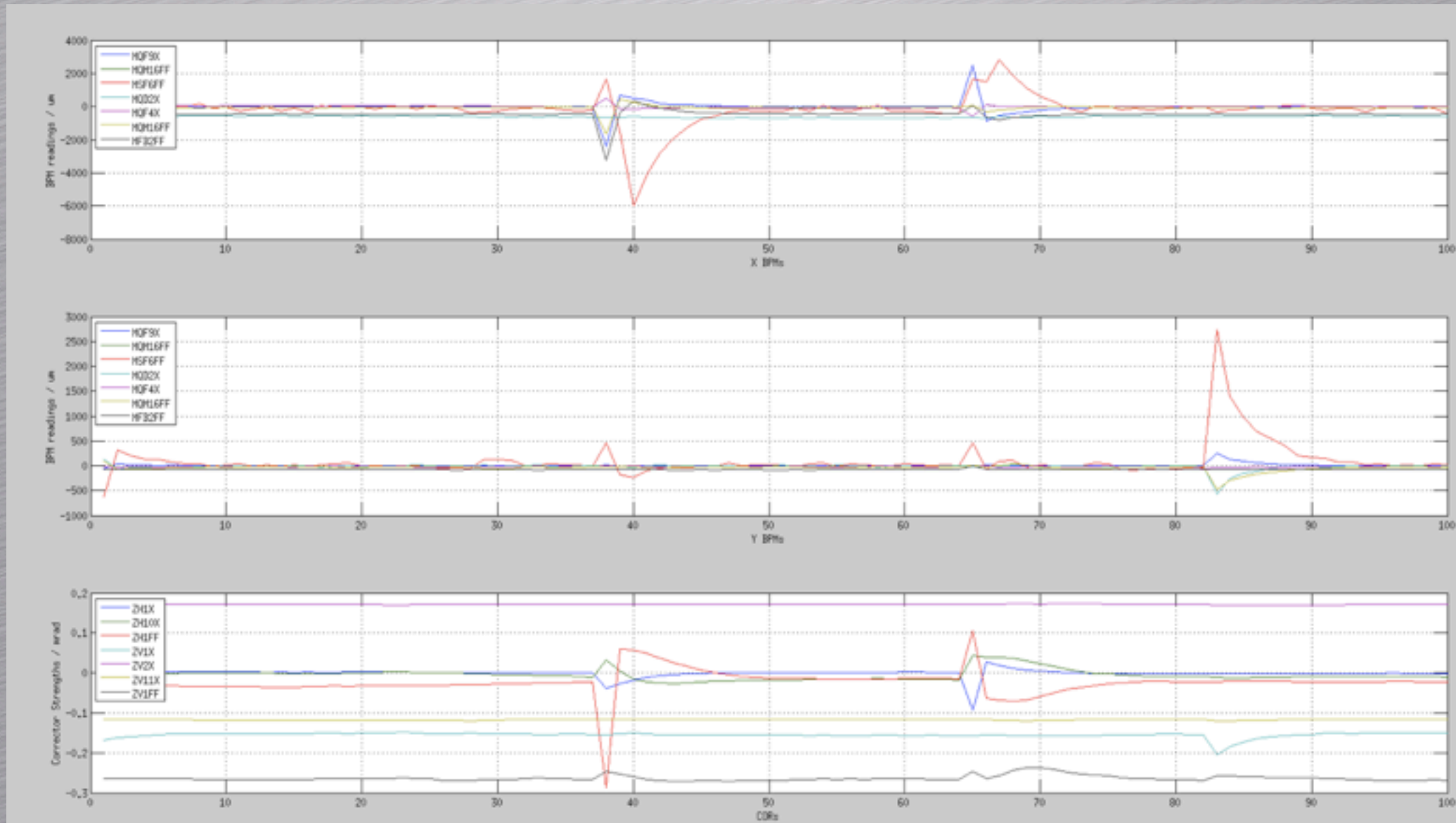
- $(B - R * C)^T * W * (B - R * C)$

- Use BPM resolutions and beta-functions at BPM locations to form weight vector.

- Apply iterative form of PI filter and write to correctors

- $C = C + P * (err - err_last) + I * err_last$

PI Setup

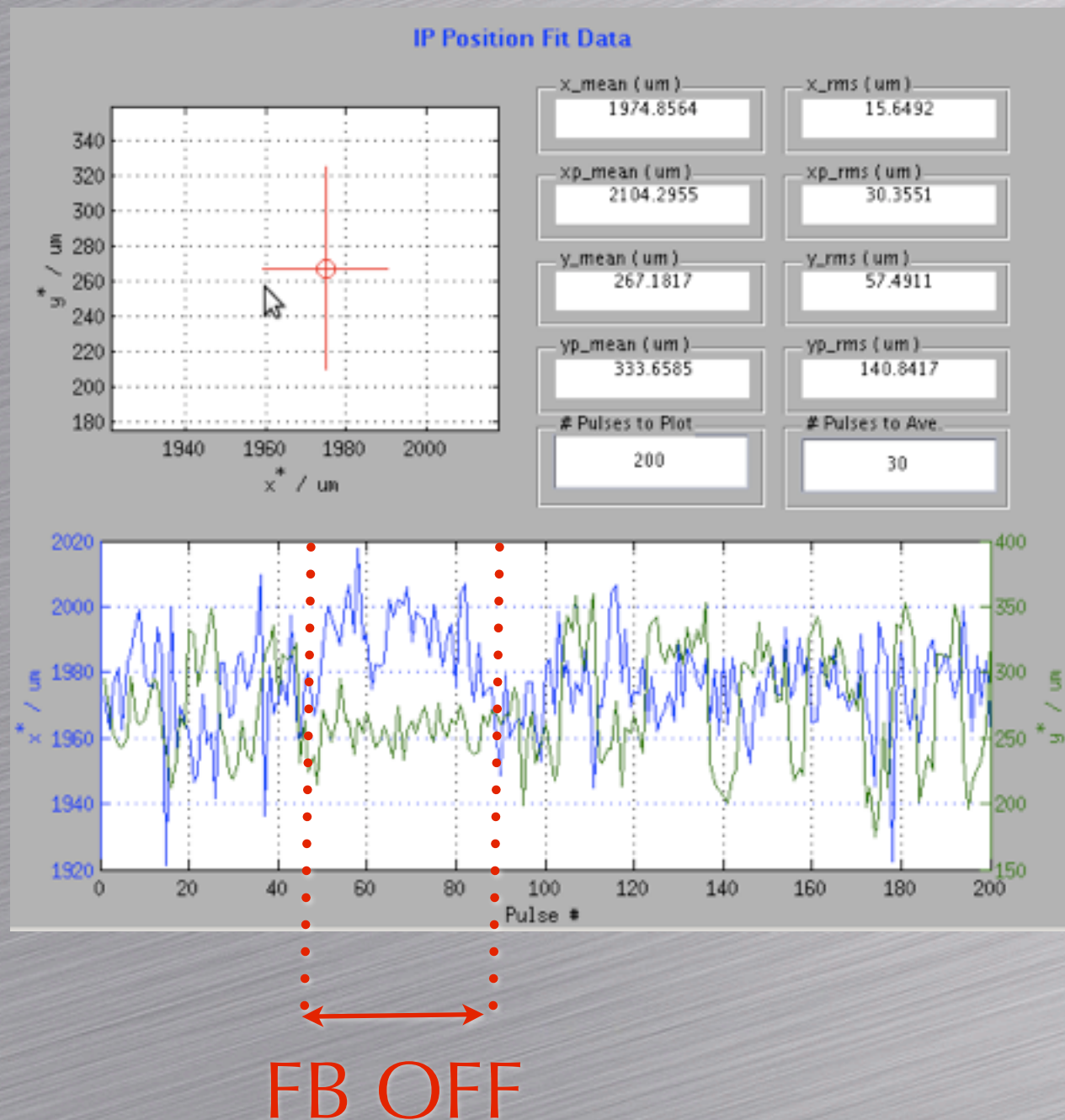


- Introduce step-disturbance (change a corrector current).
- Set $P, I=0$, increase P until correction just starts to oscillate.
- Set $P=P/2$, increase I until desired rate of convergence observed.
- Faster convergence \rightarrow larger amplification of incoherent noise.

FB Protection

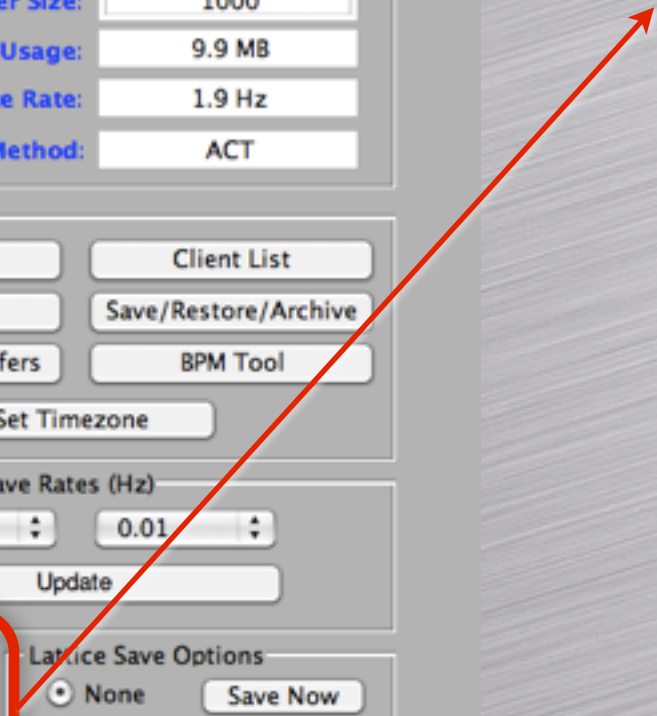
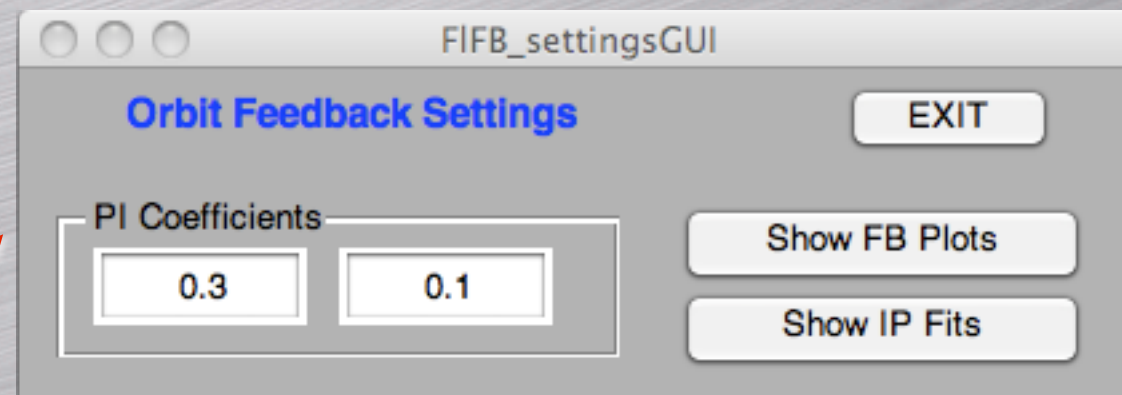
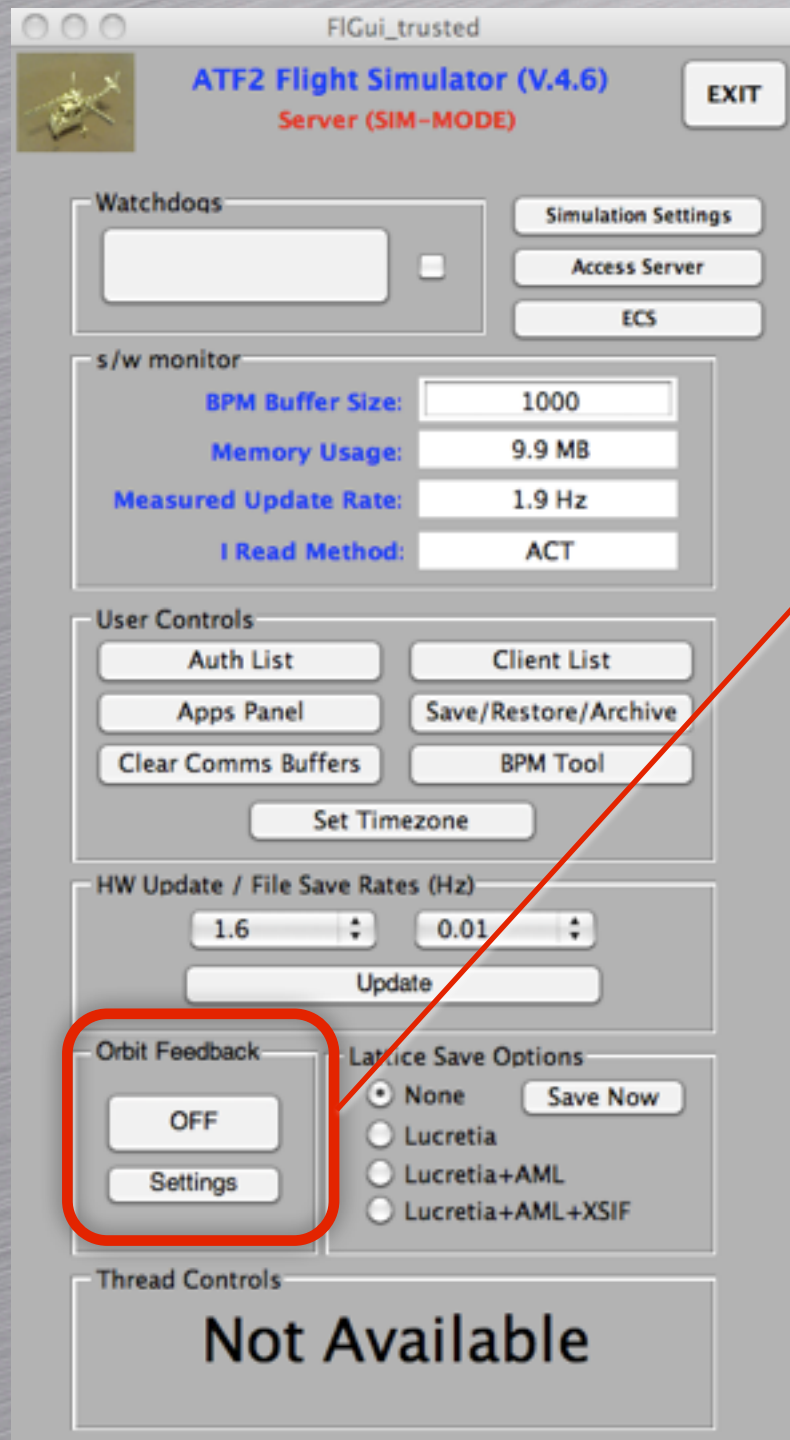
- Data quality checks needed to make sure FB does not “run-away”.
- ICTDUMP cuts to protect running FB with no or very-small charge beam.
- Cuts to throw away “flyer” BPM readings.
- Prominent button on front-panel of FS GUI to switch on/off.

IP Position Monitor



- Fit IP pos & ang from MQD0FF & M-PIP
- Useful for monitoring and restoring orbit trajectory through IPBSM region.

FS Panels



Improvements

- Interface to BPM resolution data to auto select best FB BPMs to use.
- Use Sext movers to zero sext bpms, incorporated into FB.
 - Include input from multiknob applications to define Sextupole BPM setpoints.
- Use IP monitor & QD0 moves to maintain IP trajectory desired by IPBSM.