Status Report of 3D Tracker

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ISIM test of 2D fitter

1. Test the performance of the 2D fitter with ISIM using phase 3 data.

2. One problem (unsynchronized signals) and one bug (truncated signals) have been identified and then fixed after checking the status of signals clock by clock.
1. The signal of SL8 is not synchronized with others. It was delayed by one additional CLK compared with others.
Problem of truncated signals

1. Some data are truncated after resizing.

- The integer signals in the program represent float numbers. Before sending the signal to Lut, the signal should be scaled and resized because the size of Lut is limited. However, some data are wrongly truncated because the bit size after resizing is too small.

```c
if (tan_phi0a<decimal_string_to_signed("-395109803",30)) then
tan_phi0a_ml<decimal_string_to_signed("-395109803",30);
elseif (tan_phi0a<decimal_string_to_signed("-25254",15)) then
tan_phi0a_ml<resize(resize(tan_phi0a,16),30);
elseif (tan_phi0a<decimal_string_to_signed("-25254",16),30)) then
tan_phi0a_ml<resize(decimal_string_to_signed("-25254",16),30);
elseif (tan_phi0a<decimal_string_to_signed("-395109803",30))) then
tan_phi0a_ml<resize(resize(-tan_phi0a,16),30);
end if;
```

The bit size is too small, so the signal is truncated.
Latency of 2d fitter

1. Before fixing the synchronization problem of signals.
   - $\rho$: 25 CLKs
   - $\phi_0$: 28 CLKs

2. After fixing the synchronization problem of signals
   - $\rho$: 24 CLKs
   - $\phi_0$: 27 CLKs
Latency of 2d fitter
Performance of 2D fitter

Graph 1: 
\[ \text{omega}_2 \text{Dfitter} \text{ (1/GeV)} \]

Graph 2: 
\[ \text{s}_\phi \text{0 (deg)} \]
Performance of 2D fitter

**h_omega**

- Entries: 225
- Mean x: 1.065
- Mean y: 1.742
- RMS x: 0.2721
- RMS y: 0.3453

**h_phi**

- Entries: 225
- Mean x: 73.7
- Mean y: 43.23
- RMS x: 25.11
- RMS y: 17.82

Chi2: 5.82689

DOF: 1

p0: 3.522% ± 0.015

p1: 8.514493 ± 8.689235

Chi2: 6.87329

DOF: 1

p0: 5.63357 ± 72.9367

p1: -0.8272046 ± 0.327235
1. The resolution is defined as \((2dFitter - 2DFinder)/2DFinder\).
Conclusions and to do

1. After fixing the problems mentioned, the 2d fitter performs well.

The 2d fitter will be fit into the 3D firmware. Need to solve the following problems.

- Data format problem.
- Resources usage problem: the current 2D fitter may use up all the resources because of the large bit size of $\rho$ and $\phi_0$

- TSIM vs. ISIM vs. data.