ON-LINE TRACK IDENTIFICATION FOR WIRE CHAMBERS

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(presented by D. Miller)

Our wire chambers are coupled to a control computer manufactured by Digital Equipment Corporation. As you heard the other day, 18 bit wire locations are transferred into a data buffer in the computer memory. And they are also transferred from the data buffer out onto magnetic tape. This data buffer isolates the tape transport from the randomness of the event rate. It also retains wire locations in the computer memory as long as possible, so that on-line track identification and display are feasible.

An event can be transferred into the data buffer without interrupting the programme. The programme is just deferred for 5 μsec per word. Clearly there is plenty of computer time remaining for on-line track identification and display.

However, what can be done depends on the event rate and detector array size and this will change from experiment to experiment, indeed, from day to day. How should we programme the computer so that it will keep busy, always working on the highest priority job which is unfinished but still possible ?

Fortunately our computer is equipped with a programme interrupt system which allows us to assign priorities to various programme operations. If a lower priority job is being done, and it becomes possible to start a higher priority job, the computer interrupts the lower priority task, keeping track of where it is, does the higher priority task, and then returns and recommences the lower priority task. We have assigned priorities to all jobs we will want the computer to do at low counting rates or off-line.

At higher counting rates we will not have time for all these features on-line. So we will have to be satisfied with a few on-line features for all events or a more detailed on-line analysis for a smaller sample of events. And what we desire will change from hour to hour.

Our solution is to use a programme status register whose bits tell the programme whether or not a particular on-line feature is to be included. We can quickly add or subtract features of the programme. But we cannot change the priority of features.

The following list shows the on-line features which have been included so far:

COMPUTATION PRIORITIES

1. TRANSFER A SPARK LOCATION FROM THE COMPUTER MEMORY TO MAGNETIC TAPE
2. TRANSFER A SPARK LOCATION FROM THE CORE READER TO THE COMPUTER MEMORY
3. KEEP MAGNETIC TAPE TRANSPORT MOVING
4. PREPARE INCOMING DATA CHANNEL FOR ANOTHER EVENT
5. DISPLAY SPARK LOCATIONS IN ONE VIEW (LOW INTENSITY)
6. FOLLOW ALL PARTICLE TRACKS IN ONE VIEW USING A STRAIGHT LINE CRITERION
7. DISPLAY TRACK LOCI IN ONE VIEW (HIGH INTENSITY)
8. FOLLOW ALL PARTICLE TRACKS IN OTHER VIEW
9. MATCH TRACKS IN DIFFERENT VIEWS
10. TRANSFER TRACK KNOWLEDGE TO MAGNETIC TAPE
11. TYPE OUT TRACK KNOWLEDGE

If priorities 1, 2, 3 and 4 are satisfied, the tape transport is running between characters and the data channel is awaiting the next event. So the programme returns to its track identification task. It transfers an event from the data buffer into a display buffer. Remember that these wire locations are arranged in order of increasing number. It is easy to look for them.

First the programme finds a spark in the first gap. Next it counts the number of adjacent wires and finds the centre of this spark. Then it predicts a scan width just below in the second gap. It tests one wire location after another until it finds one inside the scan width. Then it finds the centre of this collection of adjacent wires and makes an improved prediction for the third gap. In this way the programme works its way down a straight line track, improving the prediction as it goes. If there are two collections within a scan width, the best choice is made. As soon as two gaps are empty within the scan width, the track end is declared. For each track the

entrance position, slope relative to normal and number of admitted wires along the track are recorded. We can handle straight lines which cross with no difficulty. So far all is in one view.

At this point we display all wire locations at low intensity and display the locus of collection centres at higher intensity. In fact, under console control we can see the programme find one spark centre after another. This feature is most valuable off-line. At low priority, we write the track identification results on magnetic tape and on the typewriter at the console.

In general our philosophy has been that there is no point in identifying tracks on-line unless you also display the results on-line. Also you rarely want to transfer track identification results onto magnetic tape on-line unless you service all events. All I have done is to sketch the present state of our programme for on-line analysis. It is developing on the firing line on a day-to-day basis.