# 9.0 What is a User Program File ?

- A user program file is an ASCII file with the .PRG filename extension that contains the user program segments for use with a potential array (.PA or .PA0).
- It shares the name of the potential array it supports. TEST.PRG would automatically be used to support the TEST.PA array.
- User programs are associated with arrays not instances.

# How SIMION Utilizes User Programs

- Each time the Fly'm button is clicked SIMION automatically compiles all user program files for any instances that have user programs attached to their associated potential array.
- If Adjustable variables are found, the user will be given a screen to view and change their initial values.
- User program segments are called only when ions are flying within the array that the user program segments support.

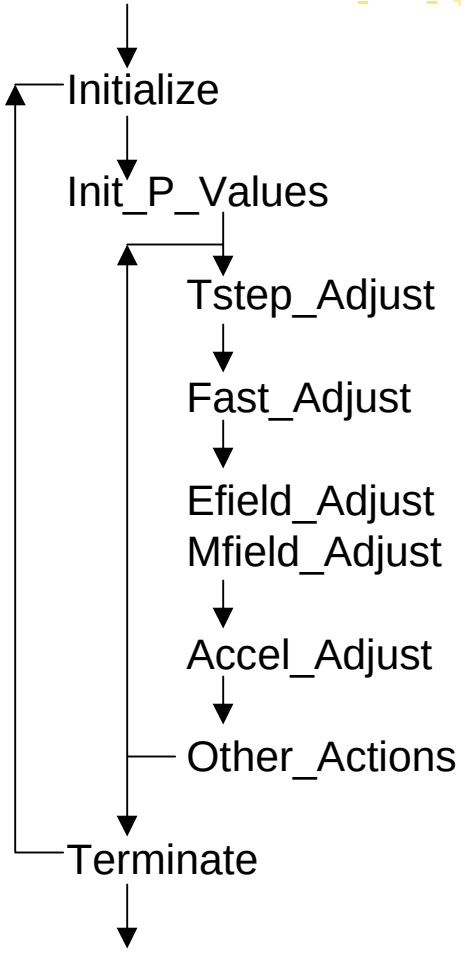
# User Program Segments

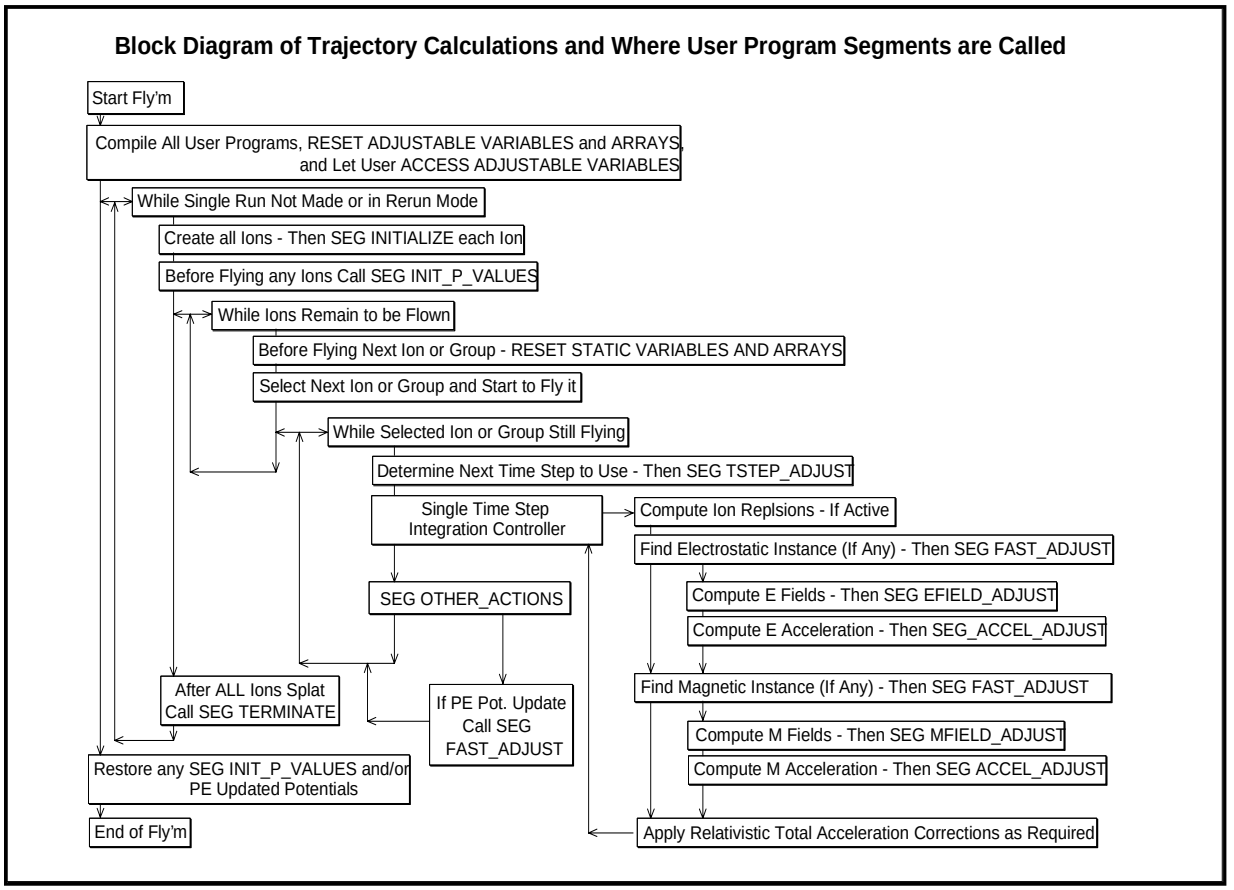
- The user program file contains user program segments.
- User program segments act like subroutines.
- SIMION calls each type of program segment at specific points in a trajectory calculation.
- Thus you must use a specific user program segment to control a specific aspect of the trajectory calculation.

# The 9 Program Segments

- Initialize
- Init_P_Values
- Tstep_Adjust
- Fast_Adjust
- Efield_Adjust
- Mfield_Adjust
- Accel_Adjust
- Terminate
- Other_Actions

# Integration into SIMION



# Example - Good Style

```
Define_Adjustable Viscous_Damping  0          ; adjustable variable Viscous_Damping
                                              ; set to 0 (no viscous damping by default)
                                              ; adjustable at the beginning of each
Fly'm

Begin_Segment Accel_Adjust                    ; start of Accel_Adjust program segment

   Recall Ion_Ax_mm                           ; recall current x acceleration (mm/usec^2)
   Recall Ion_Vx_mm                           ; recall current x velocity (mm/sec)
   Recall Viscous_Damping                     ; recall the viscous damping term
   Multiply                                   ; multiply times x velocity
   Subtract                                   ; and subtract from x acceleration
   Store Ion_Ax_mm                            ; return adjusted value to SIMION

   Recall Ion_Ay_mm                           ; recall current y acceleration (mm/usec^2)
   Recall Ion_Vy_mm                           ; recall current y velocity (mm/sec)
   Recall Viscous_Damping                     ; recall the viscous
.
.
.
   Exit                                       ; exit to SIMION (optional statement)
```

# Bad Style - no Advantage

Runs no faster than a fully commented style.

```
defa viscous_damping 0,seg accel_adjust rcl ion_ax_mm
rcl ion_vx_mm rcl viscous_damping * - sto ion_ax_mm
rcl ion_ay_mm rcl ion_vy_mm rcl viscous_damping * -
sto ion_ay_mm rcl ion_az_mm rcl ion_vz_mm
rcl viscous_damping * - sto ion_az_mm
```

# Language Rules

- Case is Ignored (upper and lower case are the same)
- Blank lines and indention's are ignored
- The Semicolon ; Starts an In-Line Comment
- The language is based on the HP RPN calculator format with a 10 register rotary stack:

  25 10 * 5 /  ;  means (25 * 10) / 5

- The Compiler looks for words and converts them into:
  - Commands
  - Numbers
  - Variable Names and Labels

# Examples of Commands

+ or: Add

Adds contents of x and y registers, puts result in y-register, and renames it as x-register ( *e.g.* 1 2 + *becomes 3 in register where 1 was originally stored*).

>KE or: Speed_to_Kinetic_Energy

Converts from speed (*mm/usec*) to kinetic energy (*eV*). On entry the x-register is assumed to contain the ion's speed and the y-register is assumed to contain the mass of the ion (*amu*). On exit the x-register contains the ion's KE and the y-register is unchanged. The >SPD command performs the reverse transformation.

# Classes of Commands

- Calculations
  + - * / SIN, COS, LOG
- Transformations
  >DEG, >RAD, >KE, >P3D, >WBC
- Flow Controls
  LBL, GSB, RTN, EXIT
- Tests (do next command if true else skip next command)
  X=0, X<=0, X!=Y, X>Y
- Communication to User and Variables
  STO, RCL, R/S, KEY?, MESSAGE

# Types of Variables

- Adjustable Variables (defined at top of program file)
  DEFA  MY_VARIABLE  30.0
  Global and lasts *throughout* a Fly'm
- Static Variables (defined at top of program file)
  DEFS  TIME_FLAG-2.0E4
  Global and Reset to initial value *before* each ion is flown
- Temporary Variables
  STO  LUCKY
  Local and Temporary:  Created with STO command.  Name must be *unique* (not Adjustable, Static, or Reserved variable name)
- Reserved Variables
  Ion_Color  Ion_Charge  Ion_Px_mm
  Used to communicate with SIMION. Each Program Segment has specific read and write access to various reserved variables.