1 Field symbols

1.1 Slc data

Special location data corresponds to maximum/ minimum values and their locations (*e.g.,* maximum traction or velocity and their spatial location) or other special positions such as crack tip and end points of process zone size. This option is mostly used in quasi-singular velocity analysis. Not only we can access the location of such points and their values (*e.g.,* maximum material speed), but also we can access other field values at these points. For example, at maximum velocity location we can access the corresponding normal traction and compare it with reference tensile strength of the interface. Values of Slc are given as:

$$\text{SlcXXYZ N} \tag{1}$$

where XX Y Z stand for the following:

1. XX:
   (a) rS: RELATIVE SPACE which is relative distance of point of interest to beginning and end of FEM process zone
   (b) aS: absolute SPACE location
   (c) vl: VALUE of the requested field
   (d) cl: COLLECTED data for requested field
2. Y:
   (a) V: VALUE of each given in C1.
   (b) D: DERIVATIVE (temporal) of each given in C1.
3. Z : only applies to cl for C1 is the COLLECTED field number
4. N: the REQUESTED field number
   (a) N: = -1, -2, -3 stands for Start, CrackTip, End of process zone size
   (b) N: $\geq$ 0 stands up for standard requested fields. The positions $N \geq 0$ DO NOT CORRESPOND to table ??. They correspond to positions that user specifies in the main config file. See discussion below.

Positions are provided by the user in the main config file. For example in configCrackPathNew.txt we have

Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
TS_ReqFldsSymbol	flds	fld0	flds	fld0	flds	fld0	flds	fld0	flds	flds	flds	flds	flds	flds	flds
TS_ReqFldsIndex	4	4	3	3	7	7	8	8	11	12	13	14	15	16	0
TS_ReqFldsFinderType_p5	max	maxAbs	max	max	max	max	max	max	max	max	max	max	max	max	max

The first line is not included in the file, but its given here to better see how N's map to particular values. For exampl $N = 0$ corresponds to field 4 (velocity from table **??** and its magnitude $flds$ maximum value (max).

Useful examples of the uses of Slc:

- SlcvlV -1 ,-2, -3: speeds of end points of process zone (-1, -3) and crack tip (-2).
- SlcaSD -2 crack speed computed by finite difference = aS (spatial location) + D (time derivative) + -2 (crack tip with N = -2).
- SlcrSV 0: Relative position (rS) of the position where the value (V) of field 0 (velocity) is maximum (velocity based crack tip) to conventional crack tip location (max stress for TSR and $d = 1^{-1}$ for damage model).
- SlcrSV 6: Simlar to previous case the relative position of when Riemann traction is maximum (field 6) to crack tip position.
- SlcaSV -1 (start of PZ), SlcaSV -3 (end of PZ), SlcaSV 0 (max $|v|$), SlcaSV 1 (max v_0), SlcaSV 2 (max traction), SlcaSV 6 (max Riemann traction). These are all Values (s) of location (aS) of points with given properties. Basically, these are different definitions of crack tip.

1.2 Fracture energy field (iF)

For Fracture Energy Dissipation Based plots:

$$\text{iFXdmY Z} \tag{2}$$

where X, Y, Z are,

1. X = type of energy related quantity:
   (a) w = E = total physical dissipation
   (b) t = dE / dt = Fracture energy flux
   (c) a = dE / da = Energy Release Rate
2. Y = dimension:
   (a) 0 to DIMENSION (2): referring to individual components.
   (b) s: refers to total value.
3. Z = the integration field number:
   (a) 0: for total macroscopic dissipation
   (b) 1: mesoscopic damage dissipation

1.3 LEFM

Refers to comparison LEFM solution. Some notations are:

- M(MODIFIED): FEM velocity is used
- Adj maximum: average, 0 degree, 180 degree value is computed
- _nG or nG: means the fact that energy release rate G is not equal to work or separation, ϕ_c is taken into account in the computation (G/phic is multiplied in radii computation)

There are four groups for LEFM fields

1. LEFMgen Z: Z is one of the following:
   (a) 0: LEFM lDot crack velocity
   (b) 1: LEFM l crack location
   (c) 2: LEFM KI_stat static stress intensity factor
   (d) 3: LEFM KI_dyn dynamic stress intensity factor (based on LEFM calculated velocity)
   (e) 4: LEFM KI_dynM dynamic stress intensity factor (based on FEM calculated velocity)
   (f) 5: LoadFar applied on far plate edge readching to crack surface
   (g) 6: LoadCrack Load that impinges on the crack surface
   (h) 7: vMax/vForce This is vMax/vForce we should get based on the value of rp(FEM)/rsv (computed from FEM vel)
   (i) 8: vMax/vForce_nG same as above but with nG
2. LEFMrs Z : Dominance radius of LEFM fields (roughly speaking $(K/s_0)^2$). Z is one of the following:
   (a) 0: r_stat derived from KI_stat
   (b) 1: r_StrsDyn derived from KI_dyn (stress based)
   (c) 2: r_StrsDynAdj derived from KI_dyn (stress based) considering teta dependence (through stress terms)
   (d) 3: r_VelDynAdj derived from KI_dyn (velocity based) considering teta dependence of velocity fields (through stress terms)
   (e) 4: r_StrsDynM same as 1 but velocity is coming from FEM solution

(f) 5: r_StrsDynAdjM same as 2 but velocity is coming from FEM solution

(g) 6: r_VelDynAdjM same as 3 but velocity is coming from FEM solution

(h) 7: r_StrsDynMFD same as 5 but velocity is coming from FEM solution (Finite Difference)

(i) 8: r_StrsDynAdjMFD same as 6 but velocity is coming from FEM solution (Finite Difference)

(j) 9: r_VelDynAdjMFD same as 7 but velocity is coming from FEM solution (Finite Difference)

3. LEFMrsRel Z : r_p / dominace radius of LEFM fields (roughly speaking $(K/s0)^2$). r_p is process zone size based on cohesive/damage model and denominator and Z numbering are exactly the same as previous part:

4. LEFMTheo Z: Theoretical computations in this order. These are the following rations (except 4) against (modified FEM) crack velocity:

   (a) rp = process zone size

   (b) rss = dynamic stress dominance radius

   (c) rsv = dynamic velocity dominance radius

   (d) $r_s tat$ = static stress dominance radius

   (e) vMax = maximum material velocity (normal to crack surface for mode I) observed.

   That is the ratios are:

   (a) 0: rprss rp / rss

   (b) 1: rprsv rp / rsv

   (c) 2: vMax2sigFrce2Crho vMax / (sigmaForce / (cd rho))

   (d) 3: vMax2cD vMax / cd

   (e) 4: rsvrss rsv / rss

   (f) 5: rstat_rss r_stat / rss

   (g) 6: cohProcessZoneSize rp

5. LEFMTheoFD Z Same as B4 but quantities are computed based on FD crack velocities.

6. group 6 to 9 are the same as groups 2. to 6 but whenever applicable the computation is corrected by nG term. for names just add 'nG' at the end of the name, e.g. LEFMTheoFD → LEFMTheoFDnG.

1.4 Further information

: For more information on construction of field values refer to SUBCONFIG_LEGEND.txt.

Table 1: Main groups of fields that can be postprocessed

Group flag	Format	Description	Example
time	time	time value	time
space	space	space value (s) along the contact / fracture surface	space
X fld0, fld1, flds	X dirInd fld(*) fldIndex	spatial Cartesian coordinate value fields on fracture surface (u, v, s, *etc.*) 0, 1 are x,y component; x is combined xy (*e.g.,* magnitue, effective stress, *etc.*) Refer to table **??**	X 1 (y) fld0 6 is u(0)
fldx	fldx ctIndex	Crack tip related values → ctIndex = 0 (ctSpeed); = 1 (PZ size); = 2, 3 (COD = crack opening displacement - I guess FD and implicit calculation methods)	fldx 0
Slc	SlcXXYZ N	Accessing extermum points (*e.g.,* max traction, velocity) and computing values based on them (*e.g.,* max velocity itself, displacement at that point, or distant to crack tip	Refer to section **??**
DspaceDT	DspaceDT	Crack tip speed using finite difference (compare with fldx 0 which is from implicit function)	
DXDT	DXDT dirInd	spatial (w.r.t. X) derivative of a field (?) CHECK THIS	
DfldDT	DfldDT fldi(?)	temporal (w.r.t. t) derivative of a field (?) CHECK THIS	
mesoARCntct	mesoARCntct	a_{cr} relative area (regularization) of contact mode in debonded zone $= \kappa$	mesoARCntct
mesoAACntct	mesoAACntct	a_{s} absolute area of contact mode $= da_{\mathrm{cr}} = d\kappa$	mesoAACntct
mesoARSep	mesoARSep	a_{sr} relative area (regularization) of separation mode in debonded zone $= 1-\kappa$	mesoARSep
mesoAASep	mesoAASep	a_{s} absolute area of separation mode $= da_{\mathrm{sr}} = d(1-\kappa)$	mesoAASep
mesoARStick	mesoARStick	a_{str} relative area (regularization) of stick mode in contact zone $= \eta$	mesoARStick
mesoAAStick	mesoAAStick	a_{st} absolute area of stick mode $= \eta d$	mesoAAStick
mesoARSlip	mesoARSlip	a_{slr} relative area (regularization) of slip mode in contact zone $= 1-\eta$	mesoARSlip
mesoAASlip	mesoAASlip	a_{sl} absolute area of slip mode $= (1-\eta)d$	mesoAASlip
mesoAABond	mesoAABond	a_{st} absolute area of bonded mode (boned + stick parts) $= \eta d + (1-d)$	mesoAABond
iF	iF(XdmY) Z	Fracture energy related (refer to section **??**)	
LEFM*	-	LEFM comparison solution and relative values w.r.t. damage/cohesive models (Refer to zzz)	-
id	id	id of the given point. specific points CT related points, extremum points, and element boundaries are specified by these flags	id
ID	ID	element ID (useful in zoomed view to see what element produces the values)	ID
normal	normal dirInd	normal vector compoent in dirInd direction	normal 1 (n_y)
col	col i	directly access components which as stored as a vector (instead of group name and indices within that)	

Table 2: Field indices for fld0, fld1, fldx options in table **??**

Field index	field name in SDG code	field notation	description
0	coh_post_process_loc_DelU	$\boldsymbol{\Delta}\mathbf{u}$	Displacement jump
1	coh_post_process_loc_SCoh	$\mathbf{s}_d$	Traction in D “damage” part (cohesive value for TSRs)
2	coh_post_process_loc_SOut	$\mathbf{s}_{\mathrm{out}}$	Exterior trace of traction
3	coh_post_process_loc_Sin	$\mathbf{s}$	Interior trace of traction
4	coh_post_process_loc_V	$\mathbf{v}$	Velocity
5	coh_post_process_loc_DelV	$\boldsymbol{\Delta}\mathbf{v}$	Velocity jump
6	coh_post_process_loc_U	$\mathbf{u}$	Displacement
7	coh_post_process_loc_Sstar	$\mathbf{s}^*$	Target traction
8	coh_post_process_loc_SGodunov	$\mathbf{s}^R$	Riemann (bonded) traction
9	coh_post_process_loc_UOut	$\mathbf{u}_{\mathrm{out}}$	Exterior trace of displacement
9	coh_post_process_loc_Damage	D	Damage (note for damage models 9 refers to this, TSR to to $\boldsymbol{\Delta}\mathbf{u}$
10	coh_post_process_loc_DamageUC	D_{uc}	Damage value before limiting between [0, 1]
11	coh_post_process_loc_DamageUCdot	$\dot{D}_{\mathrm{uc}}$	Rate of damage evolution
12	coh_post_process_loc_Damage_evol_src	S_d	Damage evolution law source term = $\frac{1}{\tau}[1 - H(< d_s - d >_+)]$
13	coh_post_process_loc_Damage_evol_force	d_s	Static damage = damage force
14	coh_post_process_loc_CharacteristicVal	$\mathbf{w}, w_i = s_i - Z_i v_i$	Characteristic value
15	coh_post_process_loc_DissDot	$\dot{E}$	Rate of energy dissipation on contact/fracture surface
16	coh_post_process_loc_Diss	E	Energy dissipation on contact/fracture surface
17	coh_post_process_loc_DissDamageDot	$\dot{E}$	For damage models
18	coh_post_process_loc_DissDamage	E	For damage model