*ALE_STRUCTURED_SENSOR

Purpose: To output element history variables of S-ALE elements during simulation at sensors generated either at an offset to Lagarange structure surface, or at spatial points whose coordinates are specified by a set of nodes or a set of solids.

A number of "csv" files are output at end of simulation or when interrupted by Ctrl+C switches. Each card uses a set of entities such as segment set, node set or solid set to generated multiple sensors. And for each sensor, a separate "csv" file is generated. Each individual sensor is an unattached node. Its node ID can be found at the header in its "csv" file. This node ID can be used to visualized its motion together with d3plot files.

Card 1	1	2	3	4	5	6	7	8
Variable	SENSORID	OPTION	SETID	XOFF	NHSV			
Type	I	A	I	F	I			
Default	none	none	none	0.0	0			

Card 2 sets extra element history variables to be outputted. It is repeated until total number of NHSV variables are read in.

Card 2	1	2	3	4	5	6	7	8
Variable	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8
Type	A	A	A	A	A	A	A	A
Default	none	None	none	none	none	none	none	none

VARIABLE	DESCRIPTION
SENSORID	Sensor ID. This ID is used to name sensor's output files. See remark 1.

VARIABLE	DESCRIPTION
OPTION	Sensor types. Please see remark 2 and 3. **SEGS_OFF:** Sensors generated at offset=XOFF of a segment set **TR_FIXED:** Tracers generated from a node set; fixed in space **TR_FLMAT:** Tracers generated from a node set; flow with material **TR_ELECT:** Tracers generated at element center from elements in an S-ALE solid element set; follow mesh motion
SID	Set ID defining an entity set ID. **Option=SEGS_OFF:** Segment set ID **Option=TR_FIXED:** Node set ID **Option=TR_FLMAT:** Node set ID **Option=TR_ELECT:** Solid set ID (Note: S-ALE solids only)
XOFF	Offset distance. Only defined for SEGS_OFF option
NHSV	Number of Extra history variables to be output per element. Please see remark 4.
Var1, …, VarN	List of extra element history variables to be output per element

Remarks:

1. **Output File Names.** For SEGS_OFF options, the filename is in the following format: "sensor"+SensorID+"_"+the nth sensor+".csv". For example: sensor00001001_002.csv contains data for the #2 sensor in SensorID 1001. TR_*option* works the same way except "tracer" replaces "sensor" in the above scheme.

2. **SEGS_OFF.** SEGS_OFF option is to generated sensors at or close to a Lagrange structure surface. Often times these sensors are used to monitoring incident pressure in the ALE fluid during fluid structure interaction. Sometimes the pressure data are used together with FSI coupling pressure collected at structure segments.

3. **TR_*options*.** Tracers have 3 options. FIXED generates an Eulerian sensor. It collects element information at a fixed spatial location.

   FLMAT generates a Lagrange tracer. It follows the fluid flow and reports element info of elements it passes through.

ELECT stands for element center. It generates sensor at S-ALE solid element center. The sensor stays at element center no matter how S-ALE mesh moves. This option generally is used to record history variable in certain S-ALE elements when mesh moves.

4. **Extra Output Variables.** For each sensor, 11 variables are output by default. They are: time, elementID (S-ALE element sensor is located), x, y, z, vx, vy, vz, pres00, dens00, temp00. Here "00" means volumetrically average value of all ALE materials in the element. If more variables are wanted, NHSV should be specified here and Card 2 must be used to set these variables.

5. **Naming Output Variables.** A variable name is composed of two parts. First is the description of the variable. There are currently 14 options: pres, dens, temp, comp, eint, ekin, volf, epsp, sxx, syy, szz, sxy, syz, szx. They stand for: pressure, density, temperature, compression ratio, internal energy, kinetic energy, volume fraction, plastic strain and six stresses.

The second part specifies the material. 00 stands for volumetric average of all ALE materials in the element; 01 is to retrieve the history variable of the first ALE multi-material; 02 the second; so on and forth.

For example: sxx00 outputs the average x stress of all fluids while comp02 reports compression ratio of the 2nd ALE multi-material only.