User Defined Function for Discrete Phase Model

Advanced UDF
Modeling Course

DPM Macros (1)

- **`Tracked_particle *p`** DPM Datatype
- DPM tracks particles in Lagrangian frame
- Particle data at current position
  - **`P_DIAM(p)`** Particle diameter
  - **`P_VEL(p)[I]`** Particle Velocity
  - **`P_T(p)`** Particle Temperature
  - **`P_RHO(p)`** Particle density
  - **`P_MASS(p)`** Particle mass
  - **`P_TIME(p)`** Current time for particle
  - **`P_DT(p)`** Particle time step
  - **`P_LF(p)`** Particle liquid fraction
  - **`P_VFF(p)`** Particle volatile fraction

DPM Macros (2)

- Values of particle properties at entry to current cell
  - `P_DIAM0(p)` Diameter
  - `P_VEL0(p)[i]` Velocity
  - `P_T0(p)` Temperature
  - `P_RHO0(p)` Density
  - `P_MASS0(p)` Mass
  - `P_TIME0(p)` Time
  - `P_LF0(p)` Liquid fraction
- Values of particle properties at injection into domain
  - `P_INIT_DIAM(p)` Diameter
  - `P_INIT_MASS(p)` Mass
  - `P_INIT_RHO(p)` Density
  - `P_INIT_TEMP(p)` Temperature
  - `P_INIT_LF(p)` Liquid fraction

DPM Macros (3)

- `P_EVAP_SPECIES_INDEX(p)` Evaporating species index in mixture
- `P_DEVOL_SPECIES_INDEX(p)` Devolatilizing species index in mixture
- `P_OXID_SPECIES_INDEX(p)` Oxidizing species index in mixture
- `P_PROD_SPECIES_INDEX(p)` Combustion product species index in mixture
- `P_CURRENT_LAW(p)` Current law index
- `P_NEXT_LAW(p)` Next particle law index

DPM Macros (4)

- Material Properties for particles

`P_MATERIAL(p)`	Material pointer for particles
`DPM_SWELLING_COEFFI(p)`	Swell coefficient for devolatilization
`DPM_EMISSIVITY(p)`	Particle radiation emissivity
`DPM_SCATT_FACTOR(p)`	Particle radiation scattering factor
`DPM_EVAPORATION_TEMPERATURE(p)`	Evaporation temperature
`DPM_BOILING_TEMPERATURE(p)`	Boiling temperature
`DPM_LATENT_HEAT(p)`	Latent Heat
`DPM_HEAT_OF_PYROLYSIS(p)`	Heat of pyrolysis
`DPM_HEAT_OF_REACTION(p)`	Heat of reaction
`DPM_VOLATILE_FRACTION(p)`	Volatile fraction
`DPM_CHAR_REACTION(p)`	Char fraction
`DPM_SPECIFIC_HEAT(p, t)`	Specific Heat at temperature t

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DPM Functions (1)

- The following functions can be modeled:
  - Body force - custom body forces on the particles
  - Drag - user defined drag coefficient between particles and fluid
  - Source Terms - access particle source terms
  - Output - user can modify what is written out to the sampling plane output
  - Erosion - called when particle encounters “reflecting” surface
  - DPM Law - custom laws for particles
  - Scalar Update - allows users to update a scalar every time a particle position is updated
  - Switch - change the criteria for switching between laws

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DPM Functions (2)

➢ **DEFINE_DPM_BODY_FORCE**	Body force
➢ **DEFINE_DPM_DRAG**	Drag
➢ **DEFINE_DPM_SOURCE**	Source terms
➢ **DEFINE_OUTPUT**	Output
➢ **DEFINE_DPM_LAW**	Custom law
➢ **DEFINE_DPM_EROSION**	Erosion
➢ **DEFINE_DPM_INJECTION_INIT**	Initialize injections
➢ **DEFINE_DPM_SCALAR_UPDATE**	Update scalars
➢ **DEFINE_DPM_SWITCH**	Switch laws

* Note: the arguments to these functions are described in the UDF manual posted in http://www.fluentusers.com/fluent6/doc/ori/html/udf/main_pre.htm

DPM Functions (3)

- The function shown models a custom law
- The parameter p is a pointer to data structure of type Tracked Particle

```
#include "udf.h"
#include "dpm.h"
DEFINE_DPM_LAW(Evapor_Swelling_Law, p, ci)
{
  real swelling_coeff = 1.1;
  /* first, call standard evaporation routine to calculate mass and
   heat transfer */
  Vaporization_Law(p);
  /* compute new particle diameter and density */
  P_DIAM(p) = P_INIT_DIAM(p)*(1. + (swelling_coeff - 1.)*
              (P_INIT_MASS(p) P_MASS(p))/
              (DPM_VOLATILE_FRACTION(p)*P_INIT_MASS(p)));
  P_RHO(p)  = P_MASS(p) / (3.14159*P_DIAM(p)
                          *P_DIAM(p)*P_DIAM(p)/6);
  P_RHO(p)  = MAX(0.1, MIN(1e5, P_RHO(p)));
}
```

DPM Functions (4)

- The law is activated through **`Define→Models→Dispersed Phase→Injections…Create`**
- The Set Injections Properties panel comes up where Custom is activated under Laws
- This brings up the Custom Laws panel where the user can specify the appropriate law