



# 15th LS-DYNA International Conference & Users Meeting

**Post-Conference Training (2 day)**  
**Wed & Thurs, June 12<sup>th</sup> & 13th, 2018, 9am-5pm**  
*Edward Hotel & Convention Center, Dearborn, MI*

## **Advanced Applications of ALE and S-ALE**

**Instructor: Ian Do Ph.D. & Hao Chen Ph.D**

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### **Objective**

This course aims to assist users from Solid Mechanics background to effectively perform fluid-structure interaction simulations using the ALE/FSI module. In this class, a clear framework of the method and easy procedure to follow will be presented intending to focus the users on learning the required keywords and parameters. The course is meant to be comprehensive covering both concepts and applications with the goal of getting the users up to speed with both ALE and S-ALE. In this 2-day seminar, ALE concepts take about half a day. The rest of the time is for the users to learn to construct pseudo ALE and S-ALE models. .. Our goal is for this seminar to provide enough information to the users to get their own models going as quickly as possible because that is where the fun begins.

### **COURSE CONTENT**

**The constructing-pseudo-models portion** - very hands-on. For each example model,

1. The instructor will define the physics of the problem.
2. The attendees are expected to conceptually construct a detailed pseudo-input file for the model themselves (pencil-paper). Focusing on just the required keywords/parameters.
3. Afterward, we will go over the modeling details together in a review.

### **ALE CONCEPTS (~1/2 day):**

- What is ALE? Lagrangian or Eulerian?  
Pros and Cons.
- Advection - Simply a remapping process.
- Complexity of multi-material ALE -  
Interface reconstruction, one-strain,  
multiple-stresses.
- FSI - Why penalty method for coupling?  
Advantages and disadvantages.

### **ADVANCED ALE APPLICATION**

#### **EXAMPLES ( 1 day):**

A number of complex examples will be worked through in class which will required student participation. We'll select and work through as many of the examples below as time allows. For the ALE approach, we may have:

- Soda can drop
- Tank sloshing and impact
- Extrusion
- Bird strike fan blade assembly model
- Projectile-target penetration modeling
- Simple flow in flexible tube
- Hydrostatic pressure initialization
- Wave impacting floating "ship" (simple model)
- Cylinder (Rocket booster) impacting water model
- Tanker floating and moving through water



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## **S-ALE MODELING CONCEPT & APPLICATIONS EXAMPLES ( ~1/2 day):**

Recently, Dr. Hao Chen has taken all the lessons learned from all previous years of experience with the original ALE solver then

- Completely redesigns the memory distributions to optimize run time and improve MPP & SMP processing.
- Completely rewrites the advection module.
- Completely rewrites the interface reconstruction module.

We chose the structured mesh assumption because it brings significant simplicity to the design of memory structure, greatly enhances robustness and efficiency due to a much cleaner coding approach. Several examples will be used to demonstrate the slightly different, and simpler, modeling techniques of the S-ALE approach.

- Rod penetration
- Explosion under a plate
- Mine blast
- Tank sloshing
- Floating boat