







### C. Effect of Water Entry Speed

Various speed cases are set to study the effect of water entry speed to the three phase flow development. Results are shown in Figure 5 in order of 50m/s, 100m/s and 150m/s.

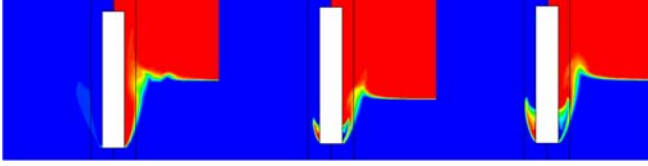


Figure 5. Profiles of phase interface (depths at the maximal natural cavity)

The left side of each picture is the contour of vapor phase, and the right side is the contour of air phase, showing the weight of each gaseous phase and the water entry cavity profile. It is quite clear that the fraction of vapor phase arises with speed, making it more important in the formation of flow. The peak size of vapor cavity appears in different penetrating depths. The results also indicate that for the model we investigated, if the speeds equal 50m/s or less, the effect of vapor phase is neglectable.

More specific information can be obtained if we examine the pressures for each case as shown in Figure 6, Figure 4 and Figure 7.

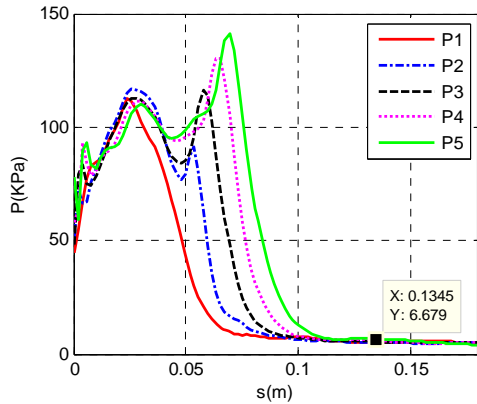


Figure 6. Pressures vs. time of 50m/s

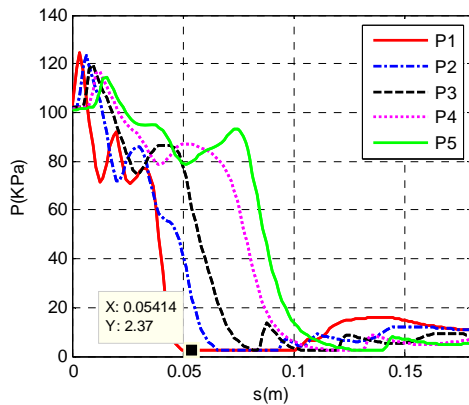


Figure 7. Pressures vs. time of 150m/s

All pressures of 50m/s case have not drop to the saturation pressure, which shows there is no macroscopical natural cavity.

Pressure features for 150m/s case are mostly same with the 100m/s case, for both of them have pressures bellow saturation pressures, and the subsequent variations due to natural cavity collapse are nearly same. However, the wider low pressure region of 150m/s case indicates a longer natural cavity.

### V. CONCLUSION

The main conclusions for can be drawn as:

- 1) Applied to simulate natural cavitation in high speed water entry process, Singhal et al cavitation Model predicts better cavity profile and force features than Schnerr-Sauer Model and Zwart-Gerber-Belamri Model.
- 2) Pressure inside water entry cavity are not necessarily equal everywhere, and the low pressure in the body shoulder region allows for the appearance of natural cavitation.
- 3) The natural cavitation volume fraction adds with water entry speed. Pressure features are mostly same for cases with natural cavitation, but if velocity is less than 50m/s for the model studied in this paper, the effect of vapor phase can be neglected.

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