

Abstract Submitted  
for the DFD12 Meeting of  
The American Physical Society

**A Further PIV Validation: The Topological Rule** JOHN FOSS, Michigan State University, DOUGLAS NEAL, LaVision Inc. — Once fully processed, a PIV image provides the velocity vectors (at discrete locations) that are projected onto the plane of the laser light sheet. These discrete vectors are to represent the continuous vector field whose validity can be negated if the vector field does not satisfy the Topological Rule (Foss 2004 and 2007). All, or a portion, of the image can be treated as a collapsed sphere with holes (if appropriate) at the perimeter and handles (if appropriate) in the interior. The Euler characteristic ( $X$ ) of the selected surface is  $X = 2 - \text{Sum}(\text{holes}) - 2\text{Sum}(\text{handles})$  (Eq.1) and  $X = 2 \text{Sum}(\text{nodes}) + \text{Sum}(1/2 \text{ nodes}) - 2 \text{Sum}(\text{saddles}) - \text{Sum}(1/2 \text{ saddles})$  (Eq.2) where the “full” singular points are in the interior and the “1/2” singular points are at the perimeter.  $X$  from (Eq.1) is known “by construction”.  $X$  from (Eq.2) is known from an analysis of the resolved vector field of the PIV image. (Note that a given image can be resolved into different regions for different  $X(1)$  values.) The Rule is satisfied if  $X(1) = X(2)$ . Examples of how these concepts have been utilized will be presented. [J. Foss, *Springer Handbook of Experimental Fluid Mechanics*, Chapter C.13, Springer-Verlag, Berlin, 2007.]

John Foss  
Michigan State University

Date submitted: 06 Aug 2012

Electronic form version 1.4