



Delft University of Technology

## Advances in the Rising Bubble Technique for discharge measurement

Hilgersom, Koen; Luxemburg, Willem; Willemsen, Geert; Busmann, Luuk

**Publication date**  
2014

### **Citation (APA)**

Hilgersom, K., Luxemburg, W., Willemsen, G., & Busmann, L. (2014). *Advances in the Rising Bubble Technique for discharge measurement*. <http://meetingorganizer.copernicus.org/EGU2014/EGU2014-3660.pdf>

### **Important note**

To cite this publication, please use the final published version (if applicable).  
Please check the document version above.

### **Copyright**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

### **Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights.  
We will remove access to the work immediately and investigate your claim.

*This work is downloaded from Delft University of Technology.  
For technical reasons the number of authors shown on this cover page is limited to a maximum of 10.*



## **Advances in the Rising Bubble Technique for discharge measurement**

Koen Hilgersom, Willem Luxemburg, Geert Willemsen, and Luuk Bussmann

Delft University of Technology, Water management, Delft, Netherlands (k.p.hilgersom@tudelft.nl)

Already in the 19th century, d'Auria described a discharge measurement technique that applies floats to find the depth-integrated velocity (d'Auria, 1882). The basis of this technique was that the horizontal distance that the float travels on its way to the surface is the image of the integrated velocity profile over depth. Viol and Semenov (1964) improved this method by using air bubbles as floats, but still distances were measured manually until Sargent (1981) introduced a technique that could derive the distances from two photographs simultaneously taken from each side of the river bank. Recently, modern image processing techniques proved to further improve the applicability of the method (Hilgersom and Luxemburg, 2012).

In the 2012 article, controlling and determining the rising velocity of an air bubble still appeared a major challenge for the application of this method. Ever since, laboratory experiments with different nozzle and tube sizes lead to advances in our self-made equipment enabling us to produce individual air bubbles with a more constant rising velocity.

Also, we introduced an underwater camera to on-site determine the rising velocity, which is dependent on the water temperature and contamination, and therefore is site-specific. Camera measurements of the rising velocity proved successful in a laboratory and field setting, although some improvements to the setup are necessary to capture the air bubbles also at depths where little daylight penetrates.

## **References**

D'Auria, L.: Velocity of streams; A new method to determine correctly the mean velocity of any perpendicular in rivers and canals, (The) American Engineers, 3, 1882.

Hilgersom, K.P. and Luxemburg, W.M.J.: Technical Note: How image processing facilitates the rising bubble technique for discharge measurement, *Hydrology and Earth System Sciences*, 16(2), 345-356, 2012.

Sargent, D.: Development of a viable method of stream flow measurement using the integrating float technique, *Proceedings of the Institution of Civil Engineers (London)*, Part 2, 71, 1-15, 1981.

Viol, V. and Semenov, V.: Experiments in measuring discharges in canals by the photo-integration method, *Soviet Hydrol. Selected Pap*, 2, 198-199, 1964.