Reviewer's report

**Title:** A novel software program for detection of potential air emboli during cardiac surgery

**Version:** 1  
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**Reviewer:** Francesco Faita

**Reviewer's report:**

This study aimed to present a new software system for quantification of potential emboli in the bloodstream during cardiac surgery by means of TEE ultrasound image analysis.

For this purpose, authors created a software algorithm called DETECTS which is claimed to be able to recognize and measure emboli originating during cardiac surgery. In this paper, authors described (partially) how the algorithm works and they presented a first in vitro validation. Moreover, they presented some data obtained from 5 patients during surgery.

Authors concluded that the software system they propose provides an accurate estimation of air bubbles present in the heart, both in terms of size and number. Moreover, they sustain that this new software can help surgeons in developing new de-airing technique thus reducing the rates of neurological complications after cardiac surgery.

These findings would be of interest for those who are involved in cardiac surgery. Moreover, authors are facing an important issue proposing a solution for neurological complication.

However, the manuscript suffers from lack of (numerical) result, in particular regarding the in vivo experimentation.

The manuscript suffers of some crucial limitations (as reported in subsequent “Major Compulsory Revisions” section) and, in my opinion, it should be considered for publication only if authors will address major compulsory revision.

**Major Compulsory Revisions:**

1. Only qualitative results are presented in in-vivo section. Moreover, data are coming from only 5 patients, which are claimed to be subjected to cardiac surgery, but without details on applied procedures. This section should be removed and should be presented in a next paper when more data will be available.

2. The software do not reconstruct a full real 3D volume and it is only presenting a potential bubble path, taking in consideration only the starting position of the recognized bubble. Authors are encouraged to better explain how they obtained the 3D reconstruction and what it represent, in order to not mislead readers.
which could believe that DETECTS implement a true 3D imaging system.

3. In vitro section is too long and it should be shortened.

4. When dealing with ultrasound image processing algorithms characterized by use of thresholds, the relationships between ultrasound machine adjustments should be dealt with great attention because it could have a great impact on reliability and reproducibility of the results. Authors only investigate (qualitatively) the sensitivity of the bubble threshold respect the MI and the gain of the ultrasound machine. However, interaction with other ultrasound machine adjustment should be also tested and reported with numerical results.

Minor Essential Revisions and Discretionary Revisions:

1. The last two sentences of “DETECTS software algorithm and interface” section (page 6, lines 9-12) are comments and they should be (re)moved.

2. Few details are reported about the software used to elaborate optical images. Did the authors develop it? If it is the case, did the authors validate it?

3. Some sentences of “In vitro validation of DETECTS” section are comments and they should be (re)moved, in particular (page 8, lines 7-10), (page 8, lines 18-20) and (page 8, lines 21-22).

4. The phenomenon of phantom bubbles presented in figure 3 and described in “In vitro validation of DETECTS” section is not so unexpected, because the experimental setup composed by a Plexiglas box filled with water and air bubble is prone to this type of ultrasound artefact caused by multiple echos. This could suggest that this experimental setup is not the optimal one for testing the algorithm and that different (larger) chamber and fluid (blood mimicking) should be considered.

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I declare that I have no competing interests