in order to obtain agreement between prescribed and calculated velocities. No such alterations were attempted using our approach; we still obtained fair agreement with Bristow's results, except at points very near the nose and tail. Our calculations were done using 44 elements.

Case 4 – Axisymmetric Airfoil-Type Shape

An axisymmetric airfoil-type shape may be obtained by combining a uniform flow, a point source, and a line sink (Robertson[16]). The exact velocity distribution for such a body with fineness ratio of 2.91 was calculated, and input to the program and results are shown in Fig. 8. Excellent agreement between the exact and computed body shapes was obtained by using 36 elements. The computed and the prescribed velocity distributions also are noted to be in excellent agreement. Results also were obtained for a body of fineness ratio 4.46. With 44 elements, very good agreement also was obtained, as shown in Fig. 9.

VI. Possible Extensions

The first of several different variations would be to improve the accuracy of the method by means of a linear variation of the source (or sink) strength over the element. Another approach to improving the accuracy of the method would be in terms of a continuous distribution of sources and sinks over the axis of the body. In this latter case, no elements would be used; the distribution is represented by a polynomial or Fourier series, with a number of unknown coefficients to be determined by use of the given velocity distribution. Either of the two approaches should allow the computation time to be cut substantially and the accuracy to be improved. Further investigation on these two improvements is currently under consideration.

VII. Conclusions

An algorithm that is simple, concise, fast, and accurate has been developed to solve the inverse problem in hydrodynamics. The method is iterative, and is based on representing bodies of revolution in axisymmetric flow by a distribution of line sources and sinks along the axis with possible inclusion of a point source or sink. The iterative scheme was made possible by the use of two equivalent conditions using a certain strategy: the tangency condition in the form $dr/dx = v/u$, and the condition $\psi = 0$ on the body surface. Rapid convergence was obtained for all examples considered; four to five iterations were sufficient to provide accurate solutions. The use of the closure condition to replace one equation of the system of linear equations [Eq. (10)] improved the conditioning of the coefficient matrix. Comparison was made to the method of Bristow when possible. The present method converged in fewer iterations with a much more simple computational procedure in each iteration. However, our method cannot deal with bodies of irregular surfaces. The algorithm outlined in this paper should be of inestimable value in the computation of low drag shapes such as torpedoes, submarines, airships, and other axisymmetric, fully submerged bodies.

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