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A computational model of the cochlea using the immersed boundary method. (English)

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In this work we describe a two-dimensional computational model of the cochlea (inner ear). The cochlea model is solved by modifying and extending Peskin's immersed boundary method, originally applied to solving a model of the heart. This method solves the time-dependent incompressible Navier-Stokes equations in the presence of immersed boundaries. The fluid equations are specified on a fixed Eulerian grid while the immersed boundaries are specified on a moving Lagrangian grid. The immersed boundaries exert forces locally on the fluid. These local forces are seen by the fluid as external forces that are added to the other forces, pressure and viscous, acting on the fluid.

MSC:

76Z99 Biological fluid mechanics
76D05 Navier-Stokes equations for incompressible viscous fluids
76M20 Finite difference methods applied to problems in fluid mechanics
92C10 Biomechanics

Keywords:

cochlea; immersed boundary method; Navier-Stokes equations; immersed boundaries; fixed Eulerian grid; moving Lagrangian grid

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References:

[1] Allen, J.B., (), 1
[2] Allen, J.B.; Sondhi, M.M., J. acoust. soc. am., 66, No. 1, 123, (1979)
[3] Bell, J.B.; Colella, P.; Glaz, H.M., J. comput. phys., 85, 257, (1989)
[4] Beyer, R.P., ()
[5] Birdsall, C.K., Plasma physics via computer simulation, (1985), McGrawHill New York
[6] Chorin, A.J., Math. comput., 22, 745, (1968)
[7] Fauci, L.J., ()
[8] Fogelson, A.L., J. comput. phys., 56, 111, (1984)
[9] LeVeque, R.J.; Peskin, C.S.; Lax, P.D., SIAM J. appl. math., 48, 191, (1988)
[10] Loh, C.H., J. acoust. soc. am., 74, 95, (1983)
[11] Peskin, C.S., J. comput. phys., 25, 220, (1977)
[12] Rhode, W.S., J. acoust. soc. am., 49, No. 4, 1218, (1971), (Part 2)
[13] Rhode, W.S., J. acoust. soc. am., 67, No. 5, 1696, (1980)
[14] Steele, C.R.; Taber, L.A., J. acoust. soc. am., 65, 1007, (1979)
[15] Steele, C.R.; Zias, J.G., J. acoust. soc. am., 77, 1849, (1985)
[16] Viergever, M.A., (), 63
[17] Viergever, M.A., J. acoust. soc. am., 64, 1048, (1978)
[18] Viergever, M.A., Mechanics of the inner ear-A mathematical approach, (1980), Delft Univ. Press Delft · Zbl 0447.76064
[19] Von Békésy, G., Experiments in hearing, (1960), McGraw-Hill New York
[20] Zias, J.G., (), 73
[21] Zwislocki, J., J. acoust. soc. am., 67, 1679, (1980)