Meskauskas, Julia; **Repetto, Rodolfo**; **Siggers, Jennifer H.**
Oscillatory motion of a viscoelastic fluid within a spherical cavity. (English) Zbl 1241.76064
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Summary: We study the motion of a viscoelastic fluid within a rigid spherical cavity with the aim of improving understanding of the motion of the vitreous humour in the human eye. The flow of vitreous humour leads to traction on the retina, which, once the retina is torn or damaged, can cause it to detach from the choroid, leading to loss of sight if left untreated. In the first part of the paper we investigate the relaxation behaviour of the fluid, the transient flow that would be observed in the stationary sphere starting from non-stationary initial conditions. For a general viscoelastic fluid we calculate the growth rates and eigenfunctions associated with the system, and we discuss two particular rheological models of the vitreous humour taken from the literature. In the second part of the paper we consider forced oscillations of the fluid, due to small-amplitude rotations of the sphere about a diameter, representing saccades of the eyeball. We conclude with a discussion of the possible occurrence of resonant phenomena and their clinical relevance.

MSC:

76A10 Viscoelastic fluids
76Z05 Physiological flows
92C35 Physiological flow

Keywords:

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Full Text: DOI

References:

[1] DOI: 10.1016/S0006-3495(80)85152-6· doi:10.1016/S0006-3495(80)85152-6
[2] Arfken, Mathematical Methods for Physicists (2001)
[3] Tanner, Engineering Rheology (2000)
[4] DOI: 10.1167/iovs.08-2891· doi:10.1167/iovs.08-2891
[5] DOI: 10.1586/17469899.2.2.255· doi:10.1586/17469899.2.2.255
[6] DOI: 10.1002/jbm.a.31769· doi:10.1002/jbm.a.31769
[7] DOI: 10.1007/s10856-010-4092-7· doi:10.1007/s10856-010-4092-7
[8] Soman, Biomed. Mater. Engng 13 pp 59– (2003)
[9] Lee, Biorheology 31 pp 327– (1994)
[10] DOI: 10.1038/sj.eye.6700187· doi:10.1038/sj.eye.6700187
[11] Lee, Biorheology 29 pp 521– (1992)
[12] DOI: 10.1088/0031-9155/50/19/021· doi:10.1088/0031-9155/50/19/021
[13] Dyson, Proceedings of the Fourth Medical Study Group (2004)
[14] DOI: 10.1007/s10237-009-0159-0· doi:10.1007/s10237-009-0159-0
[15] DOI: 10.1017/S002211200800222X · Zbl 1145.76464 · doi:10.1017/S002211200800222X
[16] DOI: 10.1088/0031-9155/43/6/001· doi:10.1088/0031-9155/43/6/001
[17] DOI: 10.1016/0010-4655(95)00072-N · Zbl 0923.76206 · doi:10.1016/0010-4655(95)00072-N
[18] DOI: 10.1016/0966-7822(94)00011-5· doi:10.1016/0966-7822(94)00011-5
[19] DOI: 10.1016/j.jbiomech.2008.04.015· doi:10.1016/j.jbiomech.2008.04.015
[20] Buchsbaum, Biorheology 21 pp 285–
[21] DOI: 10.1016/S1350-9462(99)00016-6· doi:10.1016/S1350-9462(99)00016-6
[22] DOI: 10.1006/exer.2001.1136· doi:10.1006/exer.2001.1136

paper as accurately as possible without claiming the completeness or perfect precision of the matching.