TABLE OF CONTENTS

INTRODUCTION **15**

CHAPTER 1
General issues of the solid body movement in the unlimited extent of ideal fluid **17**

1.1. Statement of the problem 18

1.2. Kinetic energy of the fluid 20

1.3. Formulae of conversion added masses to new coordinate system 23

1.4. Hydrodynamic forces and moments on solid body moving in ideal incompressible fluid 29

1.5. Ellipsoids of the added masses and added inertia moments 37

CHAPTER 2
Added masses of 2-D shapes moving in the unlimited fluid **42**

2.1. L.I. Sedov method 42

2.2. Added masses of the simplest shapes 44

2.2.1. Elliptic contour, circular contour, plate 44
2.2.2. Elliptic contour with one extending stiffener, T section 45
2.2.3. Elliptic contour with two symmetrically extending stiffener 49
2.2.4. Elliptic contour with horizontal and vertical keels 50
2.2.5. Symmetric profile made up of two intersecting plates 54
2.2.6. Circle with two hitches 55
2.2.7. Circle with two side keels 56
2.2.8. Circle with cross-like positioned keels 57
2.2.9. Circle with horizontal keels in tangent plane 59
2.2.10. Regular inscribed polygon 60
2.2.11. Foil profile of N.E. Zhukovskiy 60
2.2.12. Circle aerofoil at different coordinate axes positions 64
2.2.13. Hitch formed by circular arcs 65
2.2.14. Hexagon, orthogon, rhombus, octagon, regular tetragon with four edges 66
2.2.15. Plate with tab 68

2.3. Added masses of lattices 72

2.3.1. Two plates located at one right line 72
2.3.2. Three plates located at one right line 73

2.3.3. Plate lattice 74
2.3.4. Orthogon lattice 75
2.4. Added masses of the duplicated ship frame contour moving in unlimited fluid 75
2.5. Added masses of inclined ship frame 95
2.6. Added masses of catamarans and twin rudders 99

CHAPTER 3
Added masses of 3D bodies moving in unlimited fluid 106
3.1. Added masses of three-axial ellipsoid moving in unlimited fluid 107
3.2. Added masses of oblate spheroid, elongated ellipsoid of revolution, sphere, disc and elliptic plates 108
3.3. Added masses of thin finite-span foils 176
3.4. Added masses of thin annular cylindrical airfoil 120
3.5. Approximate methods to determine added masses of 3D bodies 122
3.5.1. Strip method 122
3.5.2. Equivalent ellipsoid method 129
3.5.3. Approximate formulae for added masses of ship hull 130

CHAPTER 4
Added masses of interacting bodies 132
4.1. Added masses during interaction of bodies moving in fluid 132
4.1.1. Statement of the problem concerning interaction of bodies moving in ideal fluid 132
4.1.2. Movement of two spheres in unlimited fluid 140
4.2. Added masses of bodies moving close to solid boundary 143
4.2.1. Sphere moving close to solid boundary 143
4.2.2. Circular cylinder moving close to solid boundary 143
4.2.3. Elliptic cylinder moving in fluid limited by flat boundary 144
4.2.4. Elliptic cylinder moving in longitudinal direction between two flat boundaries 146
4.2.5. Parallelepipeds during movement in unlimited medium and between two flat boundaries 147
4.2.6. Ellipsoid of revolution moving close to solid boundary 148
4.2.7. Three-axial ellipsoid moving close to solid boundary 150
4.2.8. System of oblate spheroids 155
4.2.9. Infinite series of three-axial ellipsoids 158
4.2.10. Sphere in different systems (chains, lattices) 158

4.2.11. Ellipsoid of revolutions moving in bisecting plane of dihedral angle.....159
4.2.12. Effect of boundary line on added masses of foils.....161
4.3. Added masses of bodies moving in enclosed spaces filled with fluid.....162
4.3.1. Movement of sphere in fluid confined within spherical concentric shell.....162
4.3.2. Ellipsoid of revolution moving in fluid within confocal elliptic cavity.....162

CHAPTER 5
Added masses of bodies moving close to fluid free surface.....164

5.1. Boundary conditions on fluid free surface.....164
5.1.1. Boundary conditions on free surface at impact of floating body.....164
5.1.2. Boundary conditions on free surface at periodic oscillations of floating body.....165
5.1.3. Boundary conditions on free surface when method of duplicated model is applied.....169
5.2. Added masses of vertical cylindrical obstacles.....171
5.3. Added masses of ship frames when ship is oscillating on free surface.....173
5.4. Added masses of inclined ship frames at motion on free surface.....193
5.5. Added masses of ship frames in case of hull vibration on undisturbed free surface.....220
5.6. Effect of free surface on added masses of fully-submerged spheres, cylinders and ellipsoids.....223
5.6.1. Fully-submerged sphere.....224
5.6.2. Circular cylinder.....225
5.6.3. Ellipsoid of revolution.....225
5.6.4. Elliptic cylinder.....227
5.6.5. Three-axial ellipsoid moving under water free surface.....228
5.7. Added masses of simplest bodies floating on water surface.....229
5.7.1. Elliptic cylinder, circular cylinder, wedge and plate floating on surface of unlimited fluid.....230
5.7.2. Sphere and ellipsoid of revolution floating on surface of fluid with unlimited depth.....234
5.7.3. Elliptic cylinder and plates floating on fluid surface close to solid boundaries.....240
5.7.4. Circular cylinder floating on fluid surface close to solid surface at vertical impact.....249
5.7.5. Ellipsoid of revolution floating in ellipsoid-shape vessel under vertical impact condition.....252

5.7.6. Sphere floating on fluid surface close to solid boundaries under vertical impact condition 254
5.7.7. Circular disc floating on fluid surface close to solid boundaries under vertical impact condition 255
5.7.8. Rectangular pontoon floating on fluid surface 258
5.7.9. Rectangular pontoon floating close to flat boundaries 258
5.8. Effect of fluid separation from body surface on added masses 265
5.9. Effect of fluid compressibility on added masses of floating plate at impact 267
5.10. Added masses of elliptic contour when lifted from water surface 267
5.11. Added masses of river vessels 269
5.12. Added masses of raft 279
5.13. Effect of solid fluid stratification on added masses of bodies moving within this fluid 280

CHAPTER 6
Methods to determine added masses under elastic oscillations of the ship hull 282

6.1. General 282
6.2. Determining added masses of hull frame cross-sections under vibration 287
6.3. Compensation factors taking into consideration 3D flow conditions around ship hull 289
6.3.1. Compensation factors for circular cylinder under transverse oscillations 289
6.3.2. Compensation factors for vibrating elliptic cylinder 293
6.3.3. Compensation factors for vibrating rectangular pontoon 293
6.3.4. Compensation factors for vibrating ellipsoid of revolution 297
6.4. Determining inertia moments of added masses under torsional vibrations of the ship hull 304
6.5. Investigation of shallow water effect on added masses of the ship hull under vertical vibration 307
6.6. Numerical methods in calculations of added masses 314

CHAPTER 7
Added masses of fluid under elastic oscillations of structures and their separate components 325

7.1. General 325

7.2. Methods to determine fluid added masses under structure oscillations 326
7.3. Added masses of multi-span plates 328
7.4. Effect of solid boundary on plate added masses 336
7.5. Added masses of ship hull grillages and fields 342
7.6. Added masses of cantilever plates 344
7.7. Added masses of shells 345
7.7.1. Cylindrical shell with unlimited length 346
7.7.2. Cylindrical shell with finite length 349
7.8. Effect of solid boundary on added masses of shells 353
7.9. Fluid added masses at complicated structure movement 357
7.9.1. Interaction of plates with reinforcing stiffeners 358
7.9.2. Interaction of the ship grillage structural components 367
7.9.3. Cylindrical shell reinforced with longitudinal stiffeners 378
7.10. Added masses of plates that have cutouts 385

CHAPTER 8
Added masses of propeller 389

8.1. Inertia forces & moments on propeller 389
8.2. Added masses of propeller blades 393
8.3. Added masses of propellers under transverse oscillations of the shafts 401
8.4. Added masses of ducted propeller 406

CHAPTER 9
Methods for experimental determination of added masses 407

9.1. Method of small oscillations 407
9.2. Small oscillations method in determining the added masses of bodies floating on water surface 409
9.3. Experimental method to determine ship added masses at speedup and deceleration 413
9.4. Method for experimental determination of vibrating model added masses 414
9.5. Determining coefficients of added masses through analogue electric and magnetic simulation 418

9.5.1. Added masses of 2D contours 422
9.5.2. Added masses of 3D bodies.....427
9.5.3. Determining added masses basing on electromagnetohydrodynamic analogy method 428
9.5.4. Some data on added masses of flat contours that were determined using electromagnetohydrodynamic analogy method 431

REFERENCES 434