Ahmad, Bashir; Alsaedi, Ahmed; Ntouyas, Sotiris K.; Tariboon, Jessada
Hadamard-type fractional differential equations, inclusions and inequalities. (English) Zbl 1370.34002

In this nicely written monograph, the authors present a comprehensive treatment of the application of the Hadamard-type fractional derivative to both fractional differential equations and fractional differential inclusions. An analysis of certain inequalities involving the Hadamard-type fractional integral are also presented.

The book begins with a quick review of the necessary material in the continuous fractional calculus as well as fixed point theory. While the review is nicely presented, those new to the field should be aware that the review is terse and would likely need to be supplemented with a more complete treatment of these topics. However, for those already familiar with these fundamental concepts, one can immediately delve into the remainder of the text after this quick review.

The remainder of the text systematically treats a variety of applications of the Hadamard-type fractional derivative – principally to differential equations and inclusions. Several of these applications include nonlocal boundary conditions, a topic of considerable current interest. Moreover, as already suggested, the authors shift back and forth between the treatment of differential equations and differential inclusions. Thus, this is an excellent reference no matter which of these topics is of interest to the reader.

The book also contains a very nicely written and interesting chapter on Hadamard-type fractional differential equations on infinite domains, a topic that is not treated as often (even in the integer-order setting) as the finite domain setting. This chapter has several interesting results and could be used as a springboard, in and of itself, for researchers interested in the specific topic of differential equations on infinite domains.

The last chapter of the text is of a somewhat different color than the preceding chapters inasmuch as it focuses on inequalities utilizing the Hadamard-type fractional integral. For example, a couple of different sections in this chapter focus on Chebyshev-type inequalities. Once again, in and of itself, this chapter might be of great use for researchers interested only in inequalities involving the Hadamard-type fractional integral.

All in all, this book is very well written and is enjoyable to read. For researchers who have a basic grasp of the fundamentals of the fractional calculus, this book will provide a wealth of ideas for research projects and, more generally, hours of interesting and worthwhile reading.

Reviewer: Christopher Goodrich (Omaha)

MSC:
34-02 Research exposition (monographs, survey articles) pertaining to ordinary differential equations
34A08 Fractional ordinary differential equations
26A33 Fractional derivatives and integrals
34A37 Ordinary differential equations with impulses
34A38 Hybrid systems of ordinary differential equations
34A60 Ordinary differential inclusions
34B10 Nonlocal and multipoint boundary value problems for ordinary differential equations
45G10 Other nonlinear integral equations
47H10 Fixed-point theorems

Keywords: fractional derivative; Hadamard-type fractional derivative; boundary value problem; nonlocal boundary conditions; differential inclusion; fixed point theorem; integral equation

Full Text: DOI