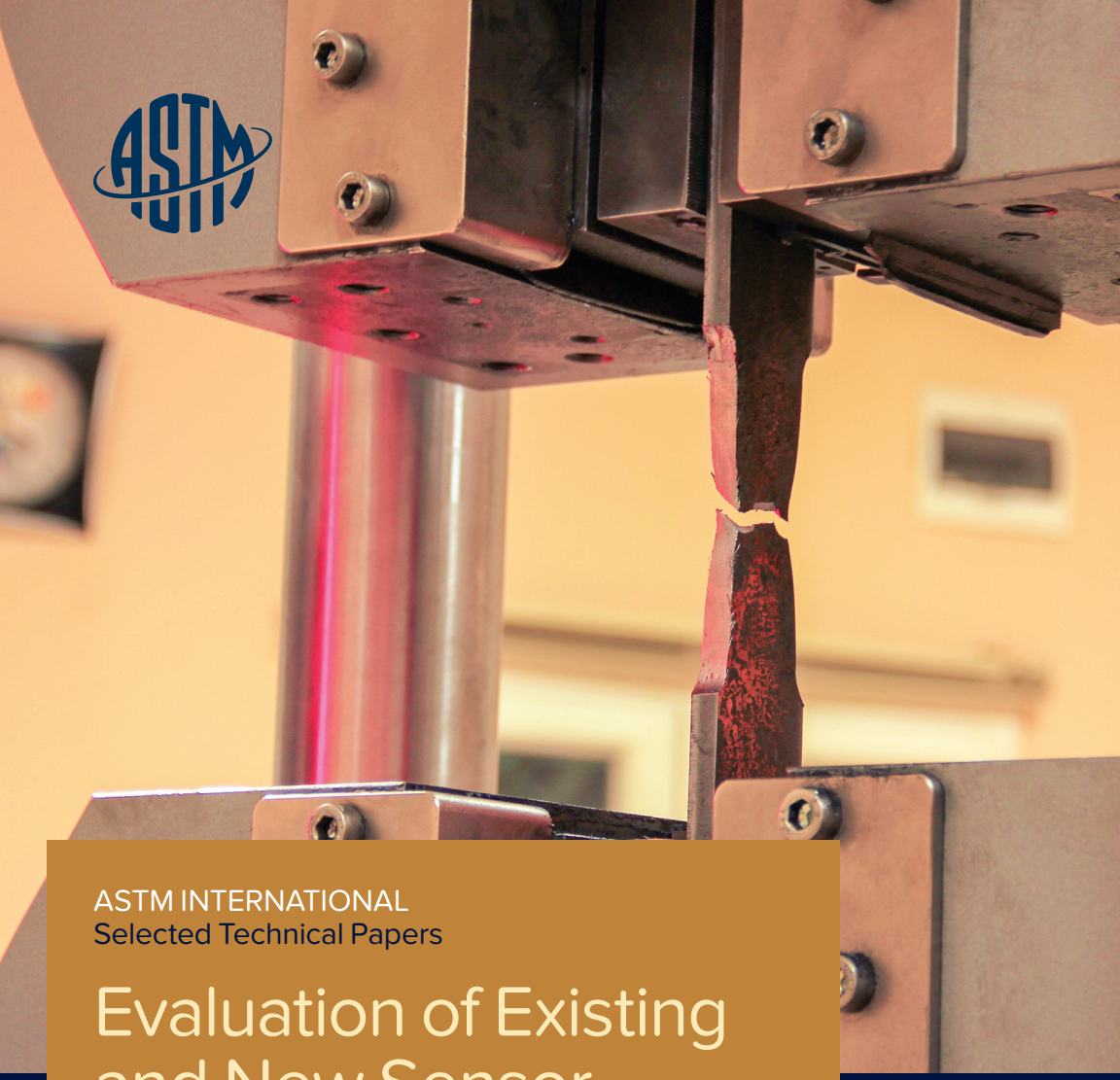

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Selected Technical Papers

Evaluation of Existing and New Sensor Technologies for Fatigue, Fracture, and Mechanical Testing

STP 1638
Editors:
Jidong Kang, Peter C. McKeighan
Gary Dahlberg, Robert Kemmerer

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Dedicated to Gary Dahlberg

A humble man who continually showed us how little we know

Foreword

THIS COMPILATION OF Selected Technical Papers, STP1638, *Evaluation of Existing and New Sensor Technologies for Fatigue, Fracture, and Mechanical Testing*, contains peer-reviewed papers that were presented virtually at a symposium held May 19–20, 2021. The symposium was jointly sponsored by ASTM International Committee E08 on Fatigue and Fracture, Subcommittee E08.03 on Advanced Apparatus and Techniques, and Committee E28 on Mechanical Testing.

Symposium Chairpersons and STP Editors:

Jidong Kang
CanmetMATERIALS
Hamilton, Ontario, Canada

Peter C. McKeighan
Symmetry Engineering and Forensic Consulting LLC
Shingle Springs, CA, USA

Gary Dahlberg
MTS Systems Corporation
Rio Rancho, NM, USA

Robert Kemmerer
Carpenter Technology Corporation
Reading, PA, USA

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Overview

At the core of any mechanical test (e.g., for fatigue, fracture, or mechanical property evaluations) are the transducers that are used to measure the observed behavior. Time-tested, well-developed transducers are readily available to measure the most critical solid mechanics force and displacement parameters. These transducers are based on proven sensors with known limitations and developed over decades of use. However, even the most robust sensor is challenged when applied to more aggressive test conditions (e.g., elevated temperature or aqueous environments). These types of testing conditions are well-suited to noncontact measurement methods.

This symposium is the fifth in a series focused on developments in sensor technologies used during fatigue, fracture, and mechanical testing applications. These symposia emerged from the E08.03 Advanced Apparatus and Techniques subcommittee focused on standards development and research directed toward validating the tools, techniques, and apparatus used in performing fatigue and fracture testing, especially the verification and calibration of systems and apparatus. This series of symposia provide a forum for the presentation of current research on both existing and new sensor technologies, and as such serve as an incubator for identifying new opportunities for standardization in related areas. Typical topics for the symposia include (a) calibration, verification, and traceability of the measurement techniques, (b) emerging techniques/methods, and (c) novel applications of the techniques.

The first symposium on the topic of new and existing sensor technology was in May of 1996. In the ensuing 25-plus years since these symposia started, extensive capability improvement in computer technology has hastened sensor development but more critically measurement capability. The primary challenges during testing have consequently evolved over time. Initially, the core issue was being able to extract data rapidly enough (and save it in a timely manner). Today, capturing vast amounts of data is of trivial concern; the challenge now is real-time processing to reduce the amount of data that needs to be saved to only that most essential, thereby reducing tedious post-test processing.

The development of noncontact, camera-based displacement measurement (and the associated digital image correlation techniques) has been a prevalent, heavily emphasized topic area throughout the past sensor symposia documented by

the special technical publications in this series. Topic areas have been varied, such as highly specialized applications, details regarding technique and image processing and interpreting results to infer specialized aspects of mechanical behavior.

This trend has continued in this latest symposium with over half of the submitted papers using some type of image-based measurement technique. The keynote paper by Schwarzkopf provides an excellent comparison between traditional and noncontact extensometry, capturing the viewpoint of the industrial equipment supplier. The six papers submitted that focus on digital image correlation are primarily geared toward unique and varied applications where the technique is particularly well-suited to discerning overall mechanical behavior. Applications range from a full-scale aircraft test (Backman et al.) to more localized material behavior for the other remaining digital image correlation papers included herein (Kang et al., Agha et al., Bruhis et al., Chen et al., and Kraemer et al.).

Two papers focus on nonvisual crack length measurement using potential drop (PD) methods: Harris et al. using direct current, DCPD, and Kraemer et al. using alternating current, ACPD. Acoustic emission measurements are examined during fatigue loading in a paper by Prakash et al. The final topic area in this symposium, emerging techniques, includes three papers with two focused on different techniques for crack length measurement (Zhang et al. and Lin et al.) and one examining interpretative methods based on new big data approaches (Kontsos et al.).

In summary, this symposium has highlighted the current state of ongoing research in sensor-related issues for fatigue, fracture, and mechanical testing. The continued development and application of digital image correlation methods is certainly an active area that continues to evolve as technology develops and unique applications are confronted. However, a challenge remains in the development of technical standards for the new and diverse measurement methods as they become more widely used and, in some cases, commercialized.

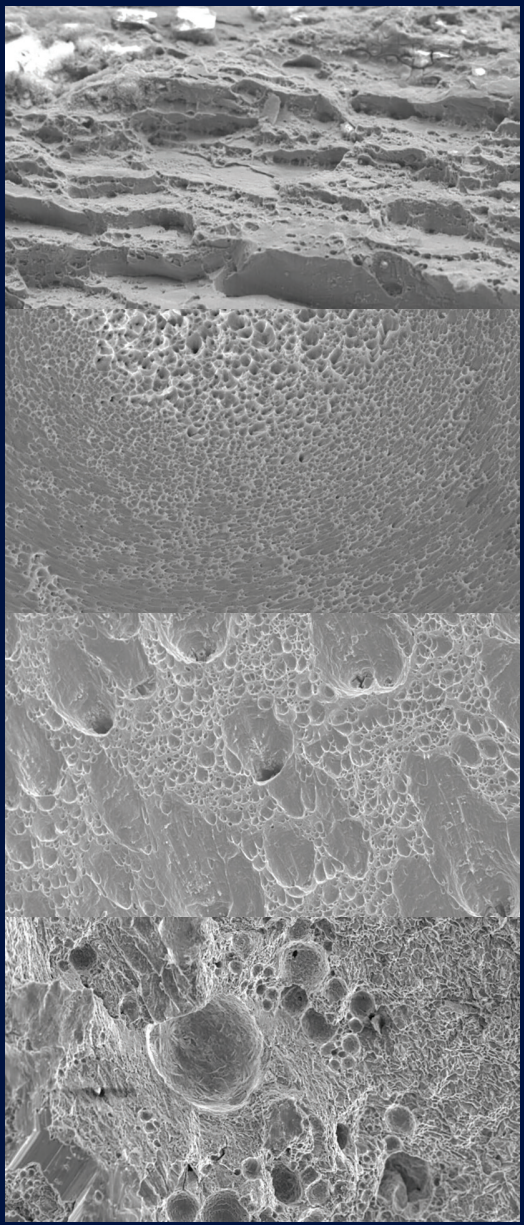
The co-editors of this symposium would like to express their sincere appreciation to all of the authors and co-authors responsible for the papers included herein and the presentations made during the symposium. Furthermore, we would like to recognize the efforts of our reviewers whose professionalism, commitment, and responsiveness have ensured the quality and timeliness of this publication. Moreover, the co-editors would also like to express their sincere gratitude to the ASTM meeting/planning and editorial staff for their assistance with the symposium and their contributions to making it a success.

Finally, we sadly note the passing of our dear colleague and co-editor, Gary Dahlberg, that occurred during the preparation of this STP. Gary's contributions in

both E28 and E08 have been significant from a technical standards development as well as leadership perspective. We will miss him greatly and will struggle to fill the void left by him. We dedicate this STP to him.

Peter C. McKeighan
Symmetry Engineering and Forensic Consulting LLC
Shingle Springs, CA, USA

Jidong Kang
CanmetMATERIALS
Hamilton, Ontario, Canada



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