DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.
FOREWORD

These published works provide a window to the Company's capabilities and they are a testimony to our concern for transfer of useful information to the world's scientific and engineering community.

All items listed are available in the libraries—books on shelves and journal articles collected in the compendium entitled "LMSC Authors in Print: 1970." Some titles published prior to 1970 are also listed; these were not received in the Technical Information Center in time for listing last year.

Reprints of journal articles normally are available directly from the authors thereof.

S. W. Burriss. President
Lockheed Missiles & Space Company
## CONTENTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Sciences</td>
<td>1</td>
</tr>
<tr>
<td>Engineering Sciences</td>
<td>7</td>
</tr>
<tr>
<td>Materials Sciences</td>
<td>11</td>
</tr>
<tr>
<td>Information Sciences</td>
<td>13</td>
</tr>
<tr>
<td>Engineering</td>
<td>15</td>
</tr>
<tr>
<td>Miscellany</td>
<td>23</td>
</tr>
<tr>
<td>Statistical Summary</td>
<td>25</td>
</tr>
</tbody>
</table>
PHYSICAL SCIENCES

The Physical Sciences Laboratory conducts basic and applied research in nuclear physics, space physics, astronomy, atomic physics, electronics and electro-optics. Nuclear physics activities are directed toward understanding the properties of nuclei, their energy levels, lifetimes, and reaction cross sections. The areas of interest for space physics research extend from the upper atmosphere outward and include the ionosphere, the magnetosphere, the interplanetary medium, and finally the interstellar region of deep space. In all these areas a vigorous experimental program using rockets and satellites is being carried out. The current interests in atomic physics are such basic properties of atoms and molecules as the energies of the excited states, the probabilities of transitions between levels, and the cross sections for excitation either by photons or by collisions with other particles. Both theoretical and experimental work on these topics are being accomplished. In electronics and electro-optics, new and improved methods of obtaining, analyzing, and transmitting information are devised. A major effort is devoted to developing the electronic and optical concepts suitable for wideband laser communication systems. The health of the research program in the Physical Sciences Laboratory in 1970 is demonstrated by the following list of publications.


CAHILL, R. W. See 44, 45.


——— See 1, 2.


See 14, 15, 16, 34, 41.


36. LEONARD, W. B. See 17.

37. MATTHEWS, J. D. See 5, 42.
McDONALD, R. E. See 7, 8, 31, 32. 38.
NAKANO, G. H. See 18.
See 55.
See 18.
RAMSEY, H. E. See 49.
See 5, 27.
ROETHIG, T. See 2.
SHARP, G. W. See 14, 15, 16. 23. 34. 41.
SHELLEY, E. G. See 47.


WEAVER, J. L. See 3.


See 39.
ENGINEERING SCIENCES

Research within the Engineering Sciences Laboratory covers such fields of endeavor as thermophysics, fluid mechanics, solid and analytical mechanics, mathematics, astrodynamics, and underwater acoustics. Thermal energy transfer, cryogenics, thermal control, and space environmental effects on space vehicles are subjects of immediate concern of thermophysics. Fluid mechanics research is oriented toward exploring the physics of planetary reentry as well as investigating the characteristics of disturbed airflow environment around hypervelocity vehicles. The extreme constraints of reliability and weightsaving imposed upon aerospace vehicles make it imperative that the analytical prediction of their mechanical response, such as stresses, deformations, and failure mode, be as realistic as possible. Solid and analytical mechanics solve these problems through research in both their theoretical and experimental phases. Current research in mathematics at LMSC covers statistics, numerical analysis, and differential equations. The astrodynamics research deals with flight performance, navigation, guidance, and the development of new tools and techniques for solving astrodynamical problems. The following list of open-literature publications may be taken as a measure of the depth of research conducted by the Engineering Sciences Laboratory.


CUFF, K. F. See 89, 90.


THOMAS, P. D. See 81.

VINOKUR, M. See 81.

The efforts of the Materials Sciences Laboratory are concentrated in three areas—metallurgy, composite materials, and chemistry. The significant engineering properties of materials depend uniquely upon their structure. Physical properties of metals, alloys, and composite materials are strongly influenced by the interactions of impurities, crystalline imperfections, substructure, and interfaces. Since the interrelationship between structure and properties is basic to metals and composite materials, the Materials Sciences Laboratory undertakes investigations that are concerned with phase equilibria and transformations, diffusion kinetics, plastic deformation, fracture phenomena, and surface effects on mechanical properties. The Chemistry Laboratory activities comprise organic chemistry ranging from synthesis of new polymers and adhesives to kinetic studies and hot atom chemistry, surface chemistry dealing with solid-gas and solid-liquid interface reactions, and general chemistry. The following open literature publications indicate the extent of the research conducted in the Materials Sciences Laboratory.
ADAMS, G. B. See 136.


CROOKS, D. D. See 132.


KINDER, W. C. See 132.


SIBERT, M. E. See 92.


See 95.
Research efforts of the Information Sciences Laboratory are concentrated in three areas: information retrieval, artificial intelligence and picture processing, and interactive systems. The basic laboratory tool in use is the IBM 360/40 computer with large, random access peripheral storage, a variety of input/output devices, and associated software. Input/output devices include both local and remote CRT displays for man-machine communication, and a program-controlled film reader which can be used to convert pictorial and graphic information into machine-readable form.

The focal point of research in information retrieval is the DIALOG system, an interactive retrieval system. Experiments in information systems and models, including management reporting and control systems, library retrieval systems, and business simulation are performed.

The artificial intelligence and picture processing programs are concerned with pictorial and graphical data processing, decision techniques, and automated means for dealing with sensor data. The goal of these research programs is to develop new techniques and to apply them in the automatic screening and man-machine processing of photograhic and sensor data.

Finally, the research in interactive systems concerns methods by which a person may interact directly with a computer to describe a problem and to guide the computer toward an acceptable solution. The ALERT system, a general-purpose on-line data management and information retrieval system, is the main vehicle for this research.

The following list of open-literature publications may be taken as a measure of the scope of research conducted by the Information Sciences Laboratory.


Mac DONALD, A. D. See 58.

ENGINEERING

Current and next generation missiles and spacecraft present engineering problems which draw consistently upon the following technologies: aerodynamics and thermodynamics, biotechnology, guidance and control, imaging and optics, information processing, power and propulsion, structures, and vehicle design and testing. The greater part of LMSC Engineering activity involves these technologies as they apply to missiles, spacecraft, and deep submersibles. Efforts are directed mainly to selected areas associated with the specific systems to be operated.

Parallel to the main concentration of system-oriented activity is a necessary effort in advanced technology which seeks to translate research findings or engineering innovations into practical techniques for missiles, spacecraft, and diversified applications. The 1970 contributions to the open literature reflect this scope of engineering activity and concentration of emphasis.


122. COX, W. P. See 4.


126. DOLTON, T. A. See 100, 108.


138. HALEN, J. D. See 135.

139. HARRIS, W. P., "Quality and Aerospace Software," Qual. Prog. 3, 4:


147. HOULE, J. F. See 155.

148. HOUSTEN, S. J. See 108.


150. JOHNSON, R. R. See 97.


165. Lott, D. R. See 117.


167. Luce, R. S. See 161.

168. MacDonald, B. A. "On-Line Defect/Failure Data System." Qual. Prog. 3. 44-47.


ROSENTHAL, J. A. See 88.
SATTERLEE, H. M. See 120.
STRUBEL, F. L. See 54.
STUCKI, F. F. See 113.
SWIDENSTEIN, S. See 151.


207. WILTNER, E. See 109.


MISCELLANY

Under this heading are grouped those publications which, although they deal with essential managerial and nontechnical aspects of the Research & Development Division, do not fit into the categories used for technical titles.


STATISTICAL SUMMARY

During 1970, LMSC authors deposited 217 published contributions in the Technical Information Center. Several works were published prior to 1970 but were never deposited heretofore; these are listed. On the other hand, 1970 imprints not received as this booklet goes to press will be listed in next year's brochure.

These publications are statistically summarized here in these categories: publishing medium, funding source, and initiating organization.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Publishing Medium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journals or Society Transactions</td>
<td>140</td>
<td>223</td>
<td>197</td>
<td>202</td>
<td>181</td>
<td>239</td>
</tr>
<tr>
<td>Symposium or Conference Pro-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ceedings</td>
<td>57</td>
<td>58</td>
<td>74</td>
<td>71</td>
<td>19</td>
<td>54</td>
</tr>
<tr>
<td>Chapters in Books</td>
<td>11</td>
<td>34</td>
<td>24</td>
<td>17</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>Books</td>
<td>9</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>217</td>
<td>320</td>
<td>301</td>
<td>296</td>
<td>237</td>
<td>331</td>
</tr>
<tr>
<td><strong>Funding Source</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR/ID*</td>
<td>30</td>
<td>48</td>
<td>46</td>
<td>48</td>
<td>49</td>
<td>65</td>
</tr>
<tr>
<td>Contract</td>
<td>39</td>
<td>62</td>
<td>55</td>
<td>44</td>
<td>37</td>
<td>56</td>
</tr>
<tr>
<td>IR/ID and Contract</td>
<td>17</td>
<td>18</td>
<td>16</td>
<td>32</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>Not Stated</td>
<td>131</td>
<td>192</td>
<td>184</td>
<td>172</td>
<td>129</td>
<td>182</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>217</td>
<td>320</td>
<td>301</td>
<td>296</td>
<td>237</td>
<td>331</td>
</tr>
<tr>
<td><strong>Initiating Organization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>President's Office</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Information Processing</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Administration</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Financial Operations</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Operations Services</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>R&amp;DD</td>
<td>137</td>
<td>206</td>
<td>241</td>
<td>230</td>
<td>211</td>
<td>292</td>
</tr>
<tr>
<td>SSD</td>
<td>54</td>
<td>28</td>
<td>29</td>
<td>33</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>MSD</td>
<td>17</td>
<td>15</td>
<td>14</td>
<td>14</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>217</td>
<td>320</td>
<td>301</td>
<td>296</td>
<td>237</td>
<td>331</td>
</tr>
</tbody>
</table>

*IR/IR – Independent Research/Independent Development Programs sponsored by Lockheed.