MACHINE-AIDED INDEXING

Paul H. Klingbiel
Directorate of Development

December 1971

Technical Progress Report for Period July 1970 - June 1971

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Machine-Aided Indexing

Technical Progress Report for Period July 1970 - June 1971

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11. SUPPLEMENTARY NOTES

Progress is reported at the 500,000-word level on the development of a partial syntactic analysis technique for indexing text. The overt error rate at this level is 3.1% (1012 overt errors in 32662 candidate index terms). New and revised indexing subroutines are provided. Computer speed is good. About one million words of text can be indexed in one hour of CPU time.
<table>
<thead>
<tr>
<th>KEY WORDS</th>
<th>LINK A</th>
<th>LINK B</th>
<th>LINK C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ROLE</td>
<td>MT</td>
<td>ROLE</td>
</tr>
<tr>
<td>Machine-aided indexing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syntactic analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index terms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error rate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This is the third annual report covering the development efforts in machine-aided indexing (MAI). The partial automation of indexing is part of a larger effort which includes the automation of bibliographic searching so that the casual on-line user can receive a reasonable response to a question expressed in natural language. Both indexing from text and the use of natural language for search and retrieval require the existence of a large natural language data base (NLDB). Machine-Aided Indexing, Machine-Aided Retrieval (MAR), and the Natural Language Data Base are all currently being developed and are at different points of completion.

The contents of this report indicate the status of MAI as of 30 June 1971. Current efforts are devoted to indexing enough text (three to four million words) so that the system may be used in an operational environment as rapidly as circumstances permit. We are attempting to hold the error rate down and maintain processing speed as the data base enlarges.

The NLDB is being constructed now using the index terms generated by MAI during the period covered by this report. We anticipate having an operational NLDB by 31 December 1971.
A contractual effort to automate the bibliographic search function has been completed, and a technical report has been issued. Additional work under the general heading of machine-aided retrieval has begun in-house. Initial efforts are devoted to a study of the retrieval lexicon; this study includes a comparison with the MAI dictionary and standard thesauri. Technical reports will be issued as information on the results of these efforts becomes available.

An effort to convert the MAI programs to COBOL is progressing satisfactorily. The existence of a conversion program will make MAI exportable. Our own in-house efforts utilize programs written in assembly language on the UNIVAC 1108 operating under EXEC 8.

Prepared by:

PAUL H. KLINDBIEL
Directorate of Development

Approved by:

PAUL A. ROBBY, JR.
Acting Director
Directorate of Development
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<th>Page</th>
</tr>
</thead>
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</tr>
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<td>• Appendix B - Format Mismatches</td>
<td></td>
</tr>
<tr>
<td>• Appendix C - Errors of Commission</td>
<td></td>
</tr>
</tbody>
</table>

iii
THE MACHINE-AIDED INDEXING SYSTEM

Recognition Dictionary

The format of this dictionary has been retained through the indexing of 565,011 words of text. All entries for that corpus are single words. No hyphenated forms or alphanumeric combinations were carried. The nine word classes established previously were retained.

The statistics for the dictionary items assigned to each macro for the 565,011 words of text are as follows:

<table>
<thead>
<tr>
<th>MACRO</th>
<th>WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1998</td>
</tr>
<tr>
<td>2</td>
<td>1721</td>
</tr>
<tr>
<td>3</td>
<td>2578</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>special symbols</td>
</tr>
<tr>
<td>6</td>
<td>2566</td>
</tr>
<tr>
<td>7</td>
<td>9659</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MACRO</th>
<th>WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>end of field</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>comma</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>hyphen</td>
</tr>
<tr>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>15</td>
<td>8</td>
</tr>
</tbody>
</table>

The computer dictionary held only 8,888 words, i.e., macro 7 was not held. A concerted effort was made to reduce the macro 7 words (mostly of low frequency) to one of the other categories. Although that task was not completed when an additional 211 DD 1634 reports became available to us, the impact can be seen in the following statistics as of 621,124 words of text. (The 56,079 words of text from the 211 reports contributed only 333 new types.)

<table>
<thead>
<tr>
<th>MACRO</th>
<th>WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4288</td>
</tr>
<tr>
<td>2</td>
<td>1926</td>
</tr>
<tr>
<td>3</td>
<td>2725</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>special symbols</td>
</tr>
<tr>
<td>6</td>
<td>2764</td>
</tr>
<tr>
<td>7</td>
<td>7152</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MACRO</th>
<th>WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>end of field</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>comma</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>hyphen test</td>
</tr>
<tr>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

The million-word mark has been exceeded, but macro assignments are not yet complete. Preliminary statistics indicate about 25,000 unique words at that level. This is a startling contrast to the finding of Kucera and Francis, who reported 50,406 unique
types at the same level. The difference cannot be explained on the basis that our vocabulary is drawn from a narrowly defined technological field while that of Kucera and Francis represents general English. The million-word data base, to be sure, is a technical English data base, but it is across the board in that it covers all of the disciplines listed in the COSATI Subject Category List. More million-word data bases are becoming available, and a report on some of their statistical features will be prepared.

Indexing Subroutines (Macros)

Unfortunately, errors appeared in the indexing routines given in the previous report. The Macro 1, pages 11 and 12 of that report, was printed with a line missing. It is given in its correct form in its entirety immediately below. Macro 4, page 13 of the previous report, had two instructions reversed. This macro, too, will be repeated in its entirety. Macro 10 is for the word "or," not the word "on" as stated in the previous report.

MACRO 1

I. Clear RR.

II. Is TS empty? If

A. YES - Read in next word.

B. NO - Do contents of FR match FD?

1. YES - Write TS on IT; clear FR, TS, and read in next word.

2. NO - Does last character in FR match either P, X, Y, A, B, or +? If

   a. YES - Drop last character in FR and last term in TS. Go to step II.

   b. NO - Does FR contain a "P?" If

      (1) YES - Does FR match any of the special "of" formats? If

         (a) YES - Does TS match special tables? If

             1. YES - Write contents of TS on IT; clear FR, TS, and read in next word.
2. NO - Do contents of FR before "P" match FD? If
   a. YES - Write TS before "of" on IT. Do contents of FR after "P" match FD? If
      i. YES - Write TS after "of" on IT; clear FR, TS, and read in next word.
      ii. NO - Clear FR, TS, and read in next word.
   b. NO - Do contents of FR after P match FD? If
      i. YES - Write TS after "of."
      ii. NO - Clear FR, TS, and read in next word.
(b) NO - Go to step IIB2b(1)(a)2.
(2) NO - Clear TS, FR, and read in next word.

MACRO 4 (and)

I. Is TS empty? If
   A. YES - Clear RR and read in next word.
   B. NO - Is last character in FR an "A?" If
       1. YES - Does FR contain less than 4 characters? If
          a. YES - Place * in FR, "and" in TS. Clear RR and read in next word.
          b. NO - Delete last symbol in FR and last term in TS and go to macro 1.
       2. NO - Go to macro 1.

The following macro is a replacement for macro 13 as given on page 11 of the previous report. Test shots with this macro have been very encouraging.
**MACRO 13**

I. Is TS empty? If

A. YES - Clear RR and read in next word.

B. NO - Store hyphen in TS - read in next word and go to step II.

II. Is word followed by a hyphen?

A. YES - Go to I B.

B. NO - Store an "A" in FR and term in TS. Read in next word.

Macro 16 is a trial balloon. Words assigned to this macro cannot occur initially. In all other respects they act like weak nouns.

**MACRO 16**

I. Is TS empty?

A. YES - Clear RR and go to macro 1.

B. NO - Store a "Z" in FR and term in TS and read in next word.

**Format Dictionary**

The 75 formats recognized by the format dictionary and the frequency of their occurrence in the 450,000-word data base are as follows:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Frequency</th>
<th>Format</th>
<th>Rank</th>
<th>Frequency</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9,518</td>
<td>ZZ</td>
<td>16</td>
<td>416</td>
<td>NZZ</td>
</tr>
<tr>
<td>2</td>
<td>7,283</td>
<td>N</td>
<td>17</td>
<td>411</td>
<td>NN</td>
</tr>
<tr>
<td>3</td>
<td>7,243</td>
<td>AZ</td>
<td>18</td>
<td>391</td>
<td>ZPN</td>
</tr>
<tr>
<td>4</td>
<td>2,355</td>
<td>ZZZ</td>
<td>19</td>
<td>368</td>
<td>ZZ ZZ</td>
</tr>
<tr>
<td>5</td>
<td>2,325</td>
<td>AZZ</td>
<td>20</td>
<td>317</td>
<td>NZ</td>
</tr>
<tr>
<td>6</td>
<td>1,886</td>
<td>NZ</td>
<td>21</td>
<td>265</td>
<td>A+AZ</td>
</tr>
<tr>
<td>7</td>
<td>1,391</td>
<td>AN</td>
<td>22</td>
<td>261</td>
<td>AA ZZ</td>
</tr>
<tr>
<td>8</td>
<td>1,273</td>
<td>ZN</td>
<td>23</td>
<td>224</td>
<td>ZZ N</td>
</tr>
<tr>
<td>9</td>
<td>820</td>
<td>ZPZ</td>
<td>24</td>
<td>164</td>
<td>Z A ZZ</td>
</tr>
<tr>
<td>10</td>
<td>712</td>
<td>AAZ</td>
<td>25</td>
<td>148</td>
<td>AZ AZ</td>
</tr>
<tr>
<td>11</td>
<td>535</td>
<td>AZ</td>
<td>26</td>
<td>115</td>
<td>AAN</td>
</tr>
<tr>
<td>12</td>
<td>510</td>
<td>AZZZ</td>
<td>27</td>
<td>112</td>
<td>AZZ ZZ</td>
</tr>
<tr>
<td>13</td>
<td>426</td>
<td>AN</td>
<td>28</td>
<td>109</td>
<td>ZAN</td>
</tr>
<tr>
<td>14</td>
<td>422</td>
<td>A ZN</td>
<td>29</td>
<td>107</td>
<td>N AZ</td>
</tr>
<tr>
<td>15</td>
<td>420</td>
<td>ZZ ZZ</td>
<td>30</td>
<td>102</td>
<td>A Z NZ</td>
</tr>
</tbody>
</table>
The first five formats by frequency rank identically to that found for the 115,094-word corpus. Additional formats will be added to the dictionary as explained on page 24. More study is needed, but the suspicion is growing that certain words are sufficiently context sensitive in terms of occurrence as word initial, medial, or final as to warrant setting up several new word classes. This, of course, would somewhat increase the number of recognized formats.

Natural Language Data Base

In an operational environment, all candidate index terms are to be screened against the NLDB. This screen has been constructed and was in keypunch at the time this report was prepared. No data on the NLDB will be available until the next reporting period.

The NLDB is intended not only to screen out all of the errors listed in appendix C, Errors of Commission, but also to screen out syntactically correct but useless terms for retrieval. Estimates of this category run as high as 16 to 20 percent of the total candidate index terms. If this estimate is validated, the MAI programs would be producing useful index and retrieval terms about 75 percent of the time.
An additional in-house effort is now underway to compare the vocabulary, both on an individual-word basis and on a retrieval index-term basis, of the language of the requester with the language of the report writer. As that material becomes available, insofar as it affects the MAI project (either in macro assignment, format occurrence, or presence in the NLDB), it will be reported as part of each annual MAI report. The material may very well be of sufficient interest to warrant separate publication.
NATURAL LANGUAGE DATA

Statistics

An interesting feature of text is the occurrence of long stretches of text, six words or more, unbroken by a throw-away word. Such sequences occurred in the initial 125,000-word base reported on previously, but were not discussed because many of them were attributable to deficient punctuation. The new data base is normal with respect to punctuation, and therefore the long stretches are an actual feature of the text.

A feeling is growing that stretches of text longer than four words are too specific for retrieval. This hunch will be checked against the stretches of text actually found in retrieval requests. Note that the present format dictionary contains the following five-word formats.

<table>
<thead>
<tr>
<th>AZZZZ</th>
<th>ZAZZZ</th>
<th>AA+AN</th>
<th>A+YAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+AZZ</td>
<td>AA+AZ</td>
<td>A+YZZ</td>
<td>AXAZZ</td>
</tr>
<tr>
<td>ZZZZZ</td>
<td>ANZZZ</td>
<td>A+AZZ</td>
<td>AXAZZ</td>
</tr>
<tr>
<td>AZAZZ</td>
<td>NAAZZ</td>
<td>A+XAN</td>
<td></td>
</tr>
</tbody>
</table>

It also contains the six-word format, AA+AZZ. Unclassified examples of these formats are given in appendix A. Statistically, there were 385 stretches of five words and 8 stretches of six words recorded by the format dictionary and accepted as candidate index terms in the 4K data base. However, if mismatches are included, the statistics are as follows:

- 776 stretches of five words
- 120 stretches of six words
- 66 stretches of seven words
- 14 stretches of eight words
- 5 stretches of nine words
- 2 stretches of ten words

Of the 983 stretches of five words or more, only 267 involved either "and," "of," "or," or "other." Consequently, the majority of these long stretches consist of adjectives and nouns only. Unclassified examples of stretches up to and including six words have been given in appendixes A and B. Unclassified stretches longer than six words are given immediately below.

Seven Words

structural electrical magnetic and optical functions materials
doppler inertial and radio inertial error analysis
organic polymeric electronic and composite ceramic materials
potential lethal incapacitating or riot control agents
Army ABM defense system ground support facilities
small stationary and portable nuclear power plants
subsonic and supersonic reaction jet flow models
high and low cycle fatigue crack growth
single or multiple stationary or moving targets
attenuated western and eastern equine encephalitis vaccines
very high and very low frequency signals
lethal and incapacitating or riot control agents
CW yag single mode single frequency laser
very low power small size frequency synthesizer
man portable and mechanized flame weapon systems
portable and tower air traffic control radios
aerial fire support air craft propulsion system
aerial fire support air craft qualification program
utility tactical transport aircraft propulsion system planning
reusable lifting reentry heat shield panel simulations
depth technical and cost effectiveness trade offs
electrical, optical, magnetic and electro acoustic properties
offensive and defensive air force weapons systems
fast neutron elastic and inelastic cross sections
reliable data compaction and automatic image processing
homogeneous and heterogeneous free turbulent mixing flows
flame and shock tube chemical kinetic studies
prototype gas turbine engine oil base stocks
civilian pay and EDP equipment rental areas
tropospheric scatter and air ground radio links
integrated maneuvering and life support system contracts
symmetry metal oxide silicon random access memory
wind tunnel and free flight test techniques
neutron elastic and inelastic scattering cross sections
free flight weapon stores environmental test criteria
dynamic crew seat crash loads test program
pylon mounted variable geometry external fuel tank
low altitude proximity low altitude proximity delay
lightweight and heavy transportable communications equipment programs
variable deflection thruster fluidic flight control system
continuous oxygen carbon dioxide ion exchange system
reliable sewage sanitary waste treatment removable systems
portable direct reading automatic ultrasonic test system
high altitude military or commercial supersonic flight
high frequency bulk and surface wave applications
compact closed cycle light weight miniature refrigerators
new wire reinforced CB composites creep rupture
low and high energy electron diffraction studies
irradiated reactor structural and fuel cladding alloys
turbojet and other air breathing propulsion systems
radioactive waste disposal system distillate cooling system
Eight Words

low energy electron diffraction high energy electron diffraction
air defense small caliber fluid propellant weapon system
nuclear weapons effects research test nuclear effects simulators
skid mounted closed Brayton cycle power conversion system
exploratory modal high powered pneumatic actuated water cannon
small gun rugged high rate reserve power sources
switch high power gallium aluminum arsenide injection lasers
depth technical and cost effectiveness trade off studies
extremely high frequency solid state delay lines amplifier
integrated airframe exhaust nozzle wind tunnel testing techniques

Nine Words

barge mounted and deep underground nuclear power plant studies
ablative structural and ablative nuclear hardened missile heat shield
liquid rocket propellant resistant long life value seat material
phase of head mounted high resolution acoustic lens sonar

Ten Words

computer science software theory pattern recognition techniques
numerical computer techniques

Some of these stretches are suspicious: for instance, the one
element of a ten-word stretch. The context of the whole sentence
reveals that a comma is missing after the first instance of "techniques."
Consequently, there is really only a seven-word stretch. On the other
hand, the last instance of the nine-word stretches is bonafide, though
peculiar. The context is:

...complete exploratory development phase of head mounted high resolution
acoustic lens sonar and prepare...

The only reason this is not an eleven-word stretch is because we have
chosen to mark "development" a throw-away word. Consequently, the
statistics made available through our indexing programs cannot be taken
as indicating "true" linguistic entities. This is a problem. One
wants to discover certain patterns of natural text both for the sake of
(1) knowing what some of the textual patterning features are and (2)
using the information, if possible, to optimize the total system. The
MAI system is deviant in the sense that each word has only one part of
speech while natural language allows lexical entities to function in a
multiplicity of ways. Additionally, the part of speech assigned does
not always conform to the traditional partitions: traditional grammar
does not distinguish between stand-alone nouns and nouns requiring
modification. Indeed, this feature is completely idiosyncratic so that
given another data base, different choices would be made without
thereby changing the basic MAI logic. Finally, there is the choice
of throw-away words, including "development," "design," etc. The
absence of such nouns and adjectives obviously influences the frequency
of occurrence of two-word, three-word, etc., adjective phrases. More
will be said about this topic at the million-word level.

Incorrect Assignment

Appendix C lists examples of various kinds of errors of commission.
Statistically, the following error pattern of commission pertains:

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Total</th>
<th>( U )</th>
<th>( C )</th>
<th>( S )</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>512</td>
<td>315</td>
<td>150</td>
<td>47</td>
<td>50.59</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>167</td>
<td>114</td>
<td>43</td>
<td>10</td>
<td>16.50</td>
</tr>
<tr>
<td>4</td>
<td>84</td>
<td>46</td>
<td>31</td>
<td>7</td>
<td>8.30</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>1.78</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>18</td>
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<td>-</td>
<td>2.47</td>
</tr>
<tr>
<td>7</td>
<td>138</td>
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</tr>
<tr>
<td>9</td>
<td>14</td>
<td>13</td>
<td>1</td>
<td>-</td>
<td>1.38</td>
</tr>
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<td>2</td>
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<td>-</td>
<td>0.20</td>
</tr>
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<td>9</td>
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<tr>
<td>TOTALS</td>
<td>1012</td>
<td>648</td>
<td>283</td>
<td>81</td>
<td>100.00</td>
</tr>
</tbody>
</table>

This table lists a few more error types than presented in the
previous report.4/ In addition, category 7, which had previously
referred to a special symbol deleting problem, has been expanded
to cover a punctuation problem involving commas. Instances are
listed in appendix C. Error type 11 requires a new syntactic
format for its correction; error type 12 is adverb-noun confusion;
error type 13 resulted from a programing error (since corrected).

For comparative purposes, the percentage of error for each error
type is listed for the 115,000- and the 450,000-word data bases.

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Five error types show percentage decreases for the 4K vs the 1K data base. These are:

Error type

2 - Adjective-noun confusion.
3 - Noun-verb confusion.
   (40% of these are words ending in "ing."
4 - "And" logic (macro 4).
6 - Goofs.
   (It is nice to see this category decrease.)
9 - Missing punctuation.
   (This verifies our remarks that the 1K data base was unusually bad with regard to punctuation. The current percentage may very well represent an unreducible residue under normal proofreading practices.)

Eight error types show percentage increases, including three new error type categories. The categories showing increases are:

Error type

1 - A preceding or a following word is a throw-away word and the partial phrase identified coincidentally matches an acceptable format (this is the largest source of error). The problem will be discussed below.
5 - Style, such as adjective following noun.
7 - Special symbol problems including commas in very long phrases.
8 - Macro 8 logic (of).
10 - Adjective-verb confusion.
11 - New format required.
12 - Adverb-noun confusion.
13 - Programming error.

Error types 1 and 6 may remain high for some time. Initially, we had a working rule to the effect that a macro number would not be assigned to a word until we had at least five instances of the use of that word. This practice accounts for the inordinate number of macro 7 designations (page 1). Because several million-word bases are now becoming available and because the statistics of these bases appear to differ significantly from that of Kucera and Francis, we are now making decisions on all words. This policy will probably result in more type 1 and 6 errors, but it will give us a statistically clean file.

The following words, in alphabetical order, were responsible for the type 1 errors. The frequency of the word through 565,000 words of text is given, the macro number assigned at the time indexing took place, and the new macro assignments, if any. There has not been time
to review all of the words, and there is no implication that such review will necessarily result in a macro change. Some errors will be unavoidable. The number in parentheses to the left of some words indicates the number of times the word caused trouble. All other words caused trouble only once.

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A high frequency term such as "advanced" is extremely tedious to recheck and its potential payoff is very small. The fact that the word was a throw-away word caused only a single error despite its high frequency of occurrence. A word like "Asian," on the other hand, has a high payoff. Although it occurred only twice, our failure to mark it caused an error.

From a slightly different point of view, words like "unit" (modular x-ray unit), "device" (coaxial dense plasma focus device), and "technology" (naval ship hydromechanic technology) pose a different problem. The word sequences, modular x-ray, coaxial dense plasma focus, and naval ship hydromechanic, are obviously incomplete. Yet, from a retrieval point of view, the addition of the missing last word does not generate a useful retrieval term. That is, words like "unit," "device," and "technology" appear to serve more as phrase "completers" than as useful retrieval concepts. Indeed, except for their role as phrase completers, these words in isolation are much too general for retrieval.

Finally, the problem comes to this. If these and similar phrases are held to be of no utility, then nothing need be done about words like "unit," "device," and "technology." If these phrases represent useful content, even if eventually transformed, for instance, from "naval ship hydromechanic technology" to "naval hydromechanics," the completer words must appear in the indexing output in order to work with grammatically complete phrases. In this event, context sensitive
rules may be required in order to limit the selection of these
terms to just the "completer" context. At this point, no decision
on the matter has been reached.

The words, "one" and "two," appear on the list as throw-away
words. The word "three" has been marked as an adjective (macro 2).
The other numbers, "four," "five," "six," "seven," "eight," "nine,"
and "ten," are all macro 1 words. I decided to investigate the
contexts of these words to see if "three" is indeed unique or
whether we had been inconsistent in our treatment of these number
names. The relevant contexts of one, two, three and ten occur
below (numbers in parentheses indicate the frequency of this
combination).

a long term one
a manual one for
a pressing one
an explosive one
plus one (12)
weapons one
sub one
how does one construct
only one
into one
NSAP one (2)
one 2-d interior
one 10KW
one aircraft
one airman (2)
one AN/
one and
one another
one application
one area
one Army (2)
one arresting
one aspect
one at (1)
one author
one billion
one case
one cause
one complete
one compound (2)
one comprehensive
one consideration
one context (2)
one contractor
one country
one current and approved
one data reduction (2)
one day (4)
one degree

one descriptive
one design
one dimension
one due to
one ED model (2)
one effort
one employing
one existing
one exoskeletal
one fifth of
one file
one foot (2)
one for (2)
one frame
one full
one generation
one graduate
one half (3)
on the one hand (3)
one hemolytic
one Hugoniot curve
one hundred (6)
one innovation
one international
one is (3)
one jeep
one laboratory (2)
one large
one level
one library
one located
one major area (1)
one man (6)
one manufacturers (2)
one means of
one megawatt
one meter
one method
one method
one mile (2)
one million (3)
one minute
one mirror
one made
one model
one module (2)
one mold set
one molecule
one month
one more
one municipal
one munition system
one new
one nucleon mass
one objective
one of (42)
one on (5)
one optimized
one or (15)
one part
one patient
one percent
one phase
one possible
one previously established
one private
one prototype (3)
one question
one result (2)
one routine
one runway
one satellite
one sector
one segment
one sensor
one set of
one shelter
one side
one source
one stop
one study (2)
one such (3)
one system (3)
one task (67)
one team (2)
one technical (2)
one tenth
one that can
one-third
one thousand (2)
one time (3)
one timer
one-time input (3)
one to (5)
one type
one unit
one university
one wave (2)
one way
one which
one will
one wire (3)
one with
one (1) (3)
one year (16)

phase one
that one has
that one may
number one priority (2)
the one following (2)
one under
only one
NSAP one which
VLAP one (2)

NSAP two (2)
the last two
two will
two AD models
two additional (5)
two advanced
two AIM/4-D
two AIM/9-D
two analytical (2)
two and (2)
two approaches (2)
two areas (11)
two attack
two autodin
two band
two basic (3)
two bhangmeter
two books
two Boyles
two bridge (2)
two candidate
two carbon
two categories (3)
two cell
two centers
two Ch-47
two channel
two chemical
two chinese
two communities
two comparative
two compartment (2)
two competing (3)
two competitive (3)
two complete (2)
two component (3)
two components (2)
two compounds (4)
two comprehensive

two computer

two concept

two concepts

two conferences (2)
two contexts

two contractors

two contracts

two coordinated

two correlators

two-day conference

two degrees (2)

two designs

two development

two different

two dimensional (3)
two dimensions

two distinct

two documents

two double

two dual

two earlier (2)
two EATR's (2)
two efforts (4)
two electronics

two engineering (4)
two EST

two events (3)
two experimental (2)
two experiments

two exploitation

two explosions

two extensive (2)
two extreme

two fiberglass

two field

two files

two final

two fiscal

two flexibly

two flight

two fluids

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two forms

two forthcoming

two full

two fully

two functions

two FY

two general (2)
two graphical

two groups

two high

two hours

two hundred (2)
two IBM

two ICM

two identical

two IEEE

two important

two inches

two increments

two insert (2)
two international

two ion

two issues

two jeep

two junior

two kinds

two languages

two levels

two lines

two liters

two load

two main (2)
two major (7)
two manufacturers

two marking

two methods (2)
two MFR (2)
two micropounds

two miles

two million

two minor

two models (2)
two modified

two more (2)
two new (11)
two NSF

two OAR

two of (10)
two QMR

two operational

two or (5)
Despite the fact that one can immediately come up with contexts in which the number names would be useful, these contexts seem to be of very low frequency in text. The new hyphen macro will pick up any of these words, of course, when they occur in a hyphenated form such as "two-dimensional." Under normal circumstances, since all of the number names except "three" are throw-away words, none of the contexts listed for these terms appears as a candidate index term. My judgement is that we lose very little. About the only useful terms that appear with "three" involve the word, "dimensional." The other number names occur in contexts which are no more useful than the ones given here. Consequently, number names, with the exception of "three," appear to be throw-away words.

Finally, other circumstances which cause a type 1 error are the presence of an arabic number and certain abbreviations which are ambiguous and therefore are marked as a macro 1 at the moment. As an example of the number situation, consider the following contexts for the word "latitude:"

- A parallel of latitude
- 30 degrees north
- 30 degrees south latitude
- Functions of latitude and altitude
- A degree of latitude, not otherwise available
On this basis, if "latitude" were marked as macro 6, the only possible candidate index terms are those with numerals. Since we do not pick up numerals, we would get the incomplete "degrees north latitude" and "degrees south latitude." Actually, we have marked "latitude" as a macro 1, and I believe the above contexts clearly support that decision.

The problem of abbreviations can be illustrated by "IR," which may represent either "information retrieval" or "infrared," to mention only two possibilities. Macro assignments in these cases require a thorough study of context so that misleading index terms are not picked up (such terms would degrade retrieval performance).

Format Mismatches

As usual, a record was made of those strings of text which had no counterpart in the format dictionary. This record is used to determine whether significant stretches of text are being lost from a retrieval point of view. The nonmatching formats and their frequency of occurrence follow.

Mismatch Formats By Frequency

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<th>Format</th>
<th>Rank</th>
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<th>Format</th>
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Several interesting comparisons can be made with the statistics at the 100,000- and 400,000-word levels.

### 1K

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94.6% of mismatches

### 4K

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<td>3</td>
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<td>B</td>
</tr>
<tr>
<td>4</td>
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<td>A</td>
</tr>
</tbody>
</table>

93.0% mismatches
The fact that R did not occur in isolation in the larger corpus is startling. The R class contains only 8 members. The frequency of occurrence of each in each corpus is given below:

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<td>variables</td>
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<td>41</td>
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</tbody>
</table>

Except for the word, plastics, the frequencies in the 3K corpus do not scale up as might be expected. The index routines counted 64 instances of ZR, 47 of AR, 19 of ZZR, 13 of BR, and 3 of ARZ; the legitimate formats which contain R. Ten mismatches occurred on NR, 4 on AARZ, 3 on AAR, 2 on NZR and A+AAR, and 1 on A+RZ and ANR. Unusual as it appears, it is just a chance occurrence that the R class never appeared in isolation in the 300,000-word corpus.

The overall mismatch statistics of the two corpora are quite similar. The first four format mismatches accounted for 94.6 percent of the mismatches in the first case and 94.8 percent in the second.

Formats which can be rejected immediately are also very similar in the two corpora. The first six formats in each corpus match rank exactly.

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<td>1</td>
<td>12</td>
<td>AAA+</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

The first four mismatched formats by frequency, plus the other lower frequency mismatched formats of no utility for the 1K corpus, accounted for all but 4.5 percent of the mismatches. For the 4K corpus, the first three mismatched formats, plus those others of no utility listed just above, account for all but 5.9 percent of the mismatches. Unclassified instances of each of these formats is provided.
in appendix B. A study of these mismatches has resulted in the following actions:

1) These formats have been added to the recognition dictionary on the basis that they appear to add significant retrieval terms which might otherwise be lost.

- AAZN
- ANNZ
- AZNN
- ZANZ
- A+NZ → AZ
- NZ
- A+Z1Z2Z3 → AZ2Z3
- Z1Z2Z3
- ZA1A2N → ZA1N
- ZA2N

2) The macro designation has been changed for the following words:

<table>
<thead>
<tr>
<th>Old Macro</th>
<th>New Macro</th>
<th>Old Macro</th>
<th>New Macro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>7</td>
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</tr>
<tr>
<td>7</td>
<td>6</td>
<td>7</td>
<td>2</td>
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<tr>
<td>2</td>
<td>1</td>
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<td>7</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

3) The following words have been assigned to macro 16. Their previous macro assignment is indicated.
<table>
<thead>
<tr>
<th>Old Macro</th>
<th>Old Macro</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 bound</td>
<td>0 safeguards</td>
</tr>
<tr>
<td>1 device</td>
<td>0 savings</td>
</tr>
<tr>
<td>3 growing</td>
<td>0 scene</td>
</tr>
<tr>
<td>0 routing</td>
<td>0 scenes</td>
</tr>
</tbody>
</table>

There are many more words which require analysis. We will attempt to partially automate this procedure by making the MAI routines themselves an analytical aid. Specifically, we intend to modify the MAI program so that it will accept as an accession one line at a time, where line is defined to mean the word under analysis and either two or three words on each side, provided such words exist. This means that the phrases listed on pages 14-19 for "one," "two," "three," and "ten" will be indexed with arbitrary designations for the word under analysis.

For example, if the word "one" is designated macro 1, then that word does not appear in any context as an index term. If "one" is designated macro 2, then "one" will appear initially and medially but never finally; nor can "one" occur in isolation. If "one" is designated macro 3, "one" is picked up in all positions and in isolation. If "one" is designated macro 4, then "one" will be picked up only if preceded by an adjective - definitely a context-sensitive condition.

By using the MAI programs to index those words which appear to be giving trouble, we can organize and condense the large amount of data quickly and display it in a form which will allow the best decision to be made. Errors cannot be avoided. We are looking for the best solution in terms of error rate and processing cost.
PLANS FOR FY 72

1. The data base will be doubled as a minimum.

2. The investigation of "ing" words and other troublesome words will continue.

3. A context-free grammar version of the format dictionary, now in for test, will be used to check running time.

4. The NLDB will become an operational part of MAI as the final screen of candidate index terms.

5. A report will be issued emphasizing statistics at the 1,000,000-word level.
REFERENCES


3. COSATI Subject Category List, AD 624 000, October 1965.

APPENDIX A

CURRENT FORMAT MATCHES

AAN
Acute Respiratory Diseases
Dynamic Human Perception
Military Environmental Medicine

AAZ
Biological Neural Networks
Extremely High Altitudes
Naval Oceanographic Office

AAZZ
Coated Leading Edge Structures
Flexible Offensive Gun Systems
Oscillatory Lifting Surface Theory

AA+AN
Biological, Chemical and Physical Oceanography
Biological Oceanography
Chemical Oceanography
Physical Oceanography

Unconventional, Electromagnetic and Inertial Sensors
Unconventional Sensors
Electromagnetic Sensors
Inertial Sensors

Trained Military and Civilian Scientists
Trained Scientists
Military Scientists
Civilian Scientists

AA+AZ
Biological, Radiological and Chemical Contaminants
Biological Contaminants
Radiological Contaminants
Chemical Contaminants

Biological Chemical and Physical Test
Biological Test
Chemical Test
Physical Test

Diurnal, Seasonal and Spatial Distribution
Diurnal Distribution
Seasonal Distribution
Spatial Distribution
Digital Tachometers
Global Navigation
Polar Molecules

Electrostatic Vacuum Gyros
High Purity Gallium
Reversible Zinc Electrodes

Fixed Weapons Systems
Inertial Navigation Systems
Qualitative Construction Requirements

High Enthalpy Gas Flows
Lightweight Infantry Load Carrier
Small Arms Ground Fire

Interactive Man Machine Problem Solving
Naval Ordnance Systems Command Requirements
Variable Geometry Fuel Tank Systems

Atomic Parameters
Mach Number
Reinforced Plastics

Atmospheric Number Density
Electric Current Sheets
Ionospheric Current Systems

Hot or Cold Climates
Hard or Soft Seafloors
Single or Multiple Stresses

Approximate or Exact Solution
Caseless or Encapsulated Systems
Tactical or Strategic Intelligence

Hot Climates
Cold Climates
Hard Seafloors
Soft Seafloors
Single Stresses
Multiple Stresses

Approximate Solution
Exact Solution
Caseless Systems
Encapsulated Systems
Tactical Intelligence
Strategic Intelligence
Electronic or Proximity Time Fuzes
External or Internal Flow Systems

Biomechanical Forces
Difference Analyses
Firing Tables

Closed Cycle Environmental System
Electron Beam Ferroelectric Memories
Gamma Ray Spectroscopic Techniques

High Efficiency Linear Power Amplifiers
Low Altitude High Speed Flight
Solid State Visual Display System

Bipolar Power Transistors
Thin Film Capacitors
Variable Sweep Wings

Thermal Fuel Cracking System
Ultra Reliable Interphone System
Variable Stability VTOL Aircraft

Behavioral Science Variables
Human Factors Variables
Winterization System Parameters

Charged Particle Accelerator
Laminar Boundary Layers
Qualitative Flight Tests

Digital Time Division Multiplexer
Noble Gas Ion Lasers
Rechargeable Metal Air Batteries
Aerial Fire Support System  
Automatic Test Fixture Concept  
X Ray Diffraction Techniques

Close Air Support Gun System  
Forward Area Radio Relay Equipment  
Low Density Arc Jet Facility

Acoustic and Electromagnetic Camouflage  
Analog and Digital Modulation  
Bacterial and Fungal Infections

Ballistic and Orbital Vehicles  
Cardiovascular and Pulmonary Function  
Gaussian and Exponential Functions

Acoustic and Electromagnetic Wave Propagation  
Incendiary and Flame Fuel Formulations  
Mid and High Intensity Conflict

Incendiary and Flame Fuel Formulations  
Mid Intensity Conflict  
High Intensity Conflict

Ballistic Vehicles  
Orbital Vehicles  
Cardiovascular Function  
Pulmonary Function  
Gaussian Functions  
Exponential Functions

Acoustic Camouflage  
Electromagnetic Camouflage  
Analog Modulation  
Digital Modulation  
Bacterial Infections  
Fungal Infections
Electronic and Photographic Signal Recording Media
Seismic and Infrasonic Wave Propagation Phenomena
Flame and Incendiary Weapon Effectiveness Methodology

Acoustic and Other Theory Acoustic Theory
Modular and Other Standard Modular Standard
Applications Structural Applications

Ferromagnetic and Other Signal Processing Ferromagnetic Signal Processing
Nuclear and Other Munition Devices Nuclear Munition Devices
Spectral and Other Measurement Equipment Spectral Measurement Equipment

Physiological and Threshold Effects Physiological Effects
Magnetic and Velocity Fields Threshold Effects
Wound and Burn Repair Magnetic Fields
Burn Repair Velocity Fields
Wound Repair

Local Electroanesthesia Magnetic Fields
New Lubricants Velocity Fields
Operational Hazards Wound Repair

Complex Variables New Jersey
Operational Parameters Burn Repair

Barge Mounted Nuclear Power Plant
Scramjet Powered Long Range Missile
Man Machine System Performance
Nitrogen Cross Section Data
Weapons Cost Effectiveness Analyses

Active Organic Depolarizers
Band Acoustic Transducer
Cable Mounted Sensors

Data Compaction System
Earth Moving Equipment
Field Cartographic Equipment

Glass Reinforced Plastic Structures
Heat Actuated Refrigeration System
Integral Thermal Management Techniques

Laboratory Submerged Arc Weld Compositions
Potential Hard Rock Missile Sites
Target Activated Munition Effectiveness Methodology

Accelerator Physics
Ball Ammunition
Characteristic Emissions

Explosive Ordnance Disposal
Prototype Arctic Windscreens
Tank Crew Clothing

Active Carbon Species
Body Armor Studies
Cloud Physics Data

Inlet Head Pressure Differentials
Model Dust Control Distributor

Combat Crew Training Levels
Defense Ceramics Information Center
Image Isocon TV Camera
Area of Castable Rubber
Production of Energetic Molecules
Conversion of Floating Cause Ways

Angle of Arrival
Studies of Electro-Statics
Sets of Yarns

Theory of Drag Reduction
Influence of Sand Waves
Prediction of Transpiration Temperature

Angle of Attack
Department of Defense
Equations of Motion

Function of Aerosol Environments
Studies of Electrode Behavior
Fabrication of Test Fixtures

Airplane Parameters
Circulation Patterns
Plasma Current

Energy Storage
Fire Control
Growth Requirements

Air Force Ballistic Missile
Field Chamber Comparative Studies
Oil Pollution Exploratory System
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<td>Gas Flow Tables</td>
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<td>Aircraft Fuel Tank Sealants</td>
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<td>Breech Launched Rocket Systems</td>
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<td>Jet Engine Compressor Blades</td>
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<td>Combat Vehicle Fire Control Systems</td>
<td>Combat Vehicle Fire Control Systems</td>
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<td></td>
<td>Hypervelocity Re Entry Space Vehicles</td>
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Integrated Ablative Radiative Thermal Protection Systems

Antipersonnel Flame Incendiary Studies
Bistatic HF Doppler System
Castable Elastomeric Potting Compound
Chemical Biological Radiological Materials
Coaxial Heterogeneous Mixing Configurations
Continuous Solar X Ray
Cryogenic Shipboard Electronic Systems
Electro Chromic Protective Material
Electrochemical Electromagnetic Mechanical Photoelectric
Free Turbulent Mixing Processes
Illuminated Far Infrared Photodetector
Manual Automatic Integrated Fire
Mid Infrared Spectroscopic Technique
Miniaturized Geodetic Geophysical Techniques
Multipurpose Respiratory Protective System
National Naval Medical Center
Nonflammable Nontoxic High Strength
Orthogonal Linear Phased Arrays
Packaged Airborne Electronic Equipment
Physical Chemical Electrical State
Physical Mathematical Defensive Models
Prepackaged Portable Nuclear Plant
Reinforced Oval Cylindrical Shells
Second Harmonic Cyclic Pitch
Small Flexible Digital Terminals
Tandem Van De Graaff
Three Dimensional Lifting Bodies
Timely Forward Looking Solutions
Tunable Opto Acoustic Filter
Ultra Sensitive Parametric Amplifiers
Ultra Tuned Electronic Circuits
Very High Protective Vehicle

Electronically Tuned Microelectronic Receiver Tuner
Linear Dielectric Tuning Filter Transducers
Slip Cast Fused Silica Radomes

36
Empirical Turbulent Kinetic Energy Method
Extremely Low Acoustic Propagation Velocities
Far Infrared Atmospheric Transmission Experiment
High Powered Regenerative Fuel Cell
High Precision Inertial Guidance Theory
Lightweight Pressurized Portable Plastic Extinguishers
Mos Push Down List Memory
Powered Wheeled Military Transport Vehicles
Slip Cast Fused Silica Materials
Tandem Van De Graaff Accelerator
Three Dimensional Turbulent Boundary Layers
Three Dimensional Turbulent Boundary Layer

Facsimile Auxiliary PCM Multiplexer
Living Attenuated Typhus Vaccine
Simulated South Vietnam Airfields
Soluble Phenylated Quinoxoline Polymers

Aerial Night Vision Applications
Airborne Magnetic Detection System
Audio Doppler Radar Mount
Automated Psychiatric Nursing Notes
Coherent Optical Radar Laboratory
Colored Illuminating Flares Signals
Combined Incendiary Fragmentation Effects
Compact Automatic EEG Analyzer
Controlled Airdrop Cargo System
Energetic High Nitrogen Compounds
Far Infrared Vision Systems
Flexible Integrated Intercommunications System
Heavy Single Flechette Cartridge
Lightweight Inertial Navigation System
Simulated Nuclear Blast Effects
Simulated Nuclear Weapons Effects
Simulated Nuclear Weapons Environment
Solid Chemical Oxygen Generators
Thermally Excited Nitrogen Dioxide

Automated Solar Flare Monitoring Systems
Three Free Convection Fluid Circulation Cells
Valid Small Arms Requirements Data Base

Atmospheric Environmental Parameters
Cultural Demographic Variables
Global Geodetic Parameters
High Reynolds Number
Measurable Crystallographic Parameters
Solar Geophysical Parameters

High Mach Number Flows
High Mach Number Inlet
High Reynolds Number Testing
Low Atomic Number Elements

Ambient Polar Gap Upper Atmosphere
Controllable Variable Density Optical Filters
Defensive Multiple Surface Shaped Charges
Fast Long Wavelength Infrared Detectors
Powered Aerial Targets Exhaust Plumes
Short High Frequency Electromagnetic Pulses
Very High Frequency Electromagnetic Forces
Very Long Range Strategic Forecast

Coupled Ionospheric Magnetospheric Solar Wind Systems

Automatic Electronic Antenna Coupler
Buoyant Cold Weather Clothing
Cast Foam Filled Seats
Ceramic Reinforced Plastic Laminates
Daily Northern Hemisphere Maps
Hardened Bipolar Power Transistors
High Cyclic Rate Weapons
Horizontal Airborne Transmitting Antennas
Ionized Turbulent Combustion Gases
Lightweight Cold Weather Clothing
Lightweight High Performance Cameras
Precise Faster Response Navigation
Radioactive Gaseous Waste Disposal
Redundant Hydraulic Servo Actuators
Shipboard Automatic Failure Detection
Soft X Ray Spectroscopy
Solar X Ray Flares
Supersonic Hypersonic Combustion Ramjets
Tactical Phased Array Radar
Toxic Chemical Agent Detection
Ultra Lightweight Reconnaissance Transceiver
Ultra Short Pulse Width
Very High Field Strengths
Very High Peak Spikes
Very Short Radio Wavelengths
Wideband High Power Modulators

AAZNZ

Extremely High Resolution Interferometer Spectrometer
Fourth Solar Radio Astronomy Installation
Lightweight Gyro Azimuth Surveying Instrument
Modular Chemical Agent Detection System
Nuclear Powered Energy Depot Systems

AAZZZ

Airborne Digital Computer Systems Program
Close Coupled Delta Wing Configurations
Empirical Human Performance Effectiveness Data
Extremely Hazardous Air Force Environments
HF Single Sideband Radio Sat
Hypersonic Leading Edge Heating Problem
Infrared Celestial Background Radiance Data
Integrated Topographic System Data Bank
Low Molecular Weight Combustion Products
Magnetic Annular Shock Tube Experiment
Organic Rankine Cycle Engine Generator
Self Sealing Fuel Cell Material
Shipboard Upper Air Sounding System
Solar X Ray Emission Lines
Stimulated Rayleigh Wing Light Scattering
Tactical Facsimile Target Display System
Tactical Medical Treatment Facility System
Tactical Wide Band Security Equipment
Universal High Energy Particle Detector
Chronic Low Power Density Microwave Exposure
Lightweight Reinforced Plastic Composite Gun Tubes
Miniature Combined Dosimeter Dose Rate Equipment
Rugged High Power Crystalline Laser Materials
Self Powered Flight Deck Light Water

Anti Icing and De Icing Systems
Optical Proximity and Super Quick Plug
Organic Inorganic and Organo Metallic Compounds
Rotary Winged and Fixed Winged Aircraft

Adverse Environmental and Operational Conditions
Psychological Social and Organizational Factors

Aromatic Nitro and Nitroamines
Flame Incendiary and Smoke

Infrared Acoustic and Other Detection

Automatic Diagnostic and Inspection
Civilian Pay and Benefits
Perceptual Cognitive and Motor
Physical Statistical and Engineering
Portable Mobile and Base
Satisfactory Functioning and Operation
Scientific Technological and Material
Shallow Step and Extension
Solid Hybrid and Air
Topological Statistical and Sensitivity
Turbulent Mixing and Combustion
Accelerated Wound and Fracture Healing
Atomic Molecular and Plasma Physics
Freeze Dried and Model Foods
Optical Acoustic and Radio Emissions
Visual Infrared and Millimeter Wavelengths

AA+ZZ

Automatic Diagnostic and Inspection System
Computational Environmental and Reliability Requirements
Dynamic Firings and Static Tests
Mathematical Scientific and Management Problems
Mechanical Thermal and Interface Phenomena
Military Educational and Training Problems
Nuclear Infrared and Microwave Detectors
Optoelectronic and Laser Materials
Positive Automatic and Reliable Identification
Strategic Tactical and Support Aircraft
Tactical Strategic and Reconnaissance Aircraft
Technical Financial and Planning Data
Technical Scientific and Program Management
Visual Infrared and Millimeter Wave

AA+ZZZ

Strategic Tactical and Air Lift Forces
Visual Infrared and Millimeter Wavelength Propagation

ABZ

Airborne Meteorological Data
Atmospheric Meteorological Data
Automatic Meteorological System
British Meteorological Office
Extreme Operational Environments
Increasingly Complex Input
Molecular Collision Dynamics
Naval Operational Areas
Negative Real Parts
Psychological Operational Requirements
Qualitative Quantitative Requirements
Simulated Operational Environments
Simulated Operational Environment
Technical Operational Programs
Three New Projects
Continuous Real Time Monitoring
Dynamic Real Time Information
Military Operational Support Systems
Partially Operational Army Research
Three New Work Units

Coated Tantalum Structural Elements
Low Inertia Arresting System
Low Terrain VHF Scattering
Mortar Ammunition Applied Research
Nonlinear Ordnance Dynamic Data
Phototropic Dye Nondestructive Inspection
Solar Flare X Rays

Caseless Ammunition Automatic Test Fixture
Insulating Substrate Epitaxial Semiconductor Systems
Self Healing Cold Cathode Emitters
Transonic Buffet Dynamic Load Prediction

Coated Titanium Carbon Bearings
Depleted Uranium Flechette Ammunition
Warm Fog Condensation Nuclei

Ablative Nose Cone Materials
Airborne MTI Radar Techniques
Auditory Passive Sonar Signals
Fine Dendrite Arm Spacing
Free Swimming Diver Conditions
High Purity Aluminum Oxide
Lightweight Interrogator Transponder System
Mechanized Infantry Battalion Force
Military Survival Food Packets
Simplified Speech Intelligibility Test
Variable Deflection Thruster System
Monolithic UHF Silicon Broadband Amplifier
Photographic Radar Landmass Simulation Techniques
Simulated Fog Flare Light Conditions
Small Arms Ammunition Weapon Systems

Nuclear Fallout Parameters

Chemical Ionization Mass Spectroscopy
Coupled Torsion Bending Computations
Digital Troposcatter Communications Modems
Discrete Silicon Power Transistors
Flat Trajectory Tank Cannons
High Acuity Photo Recon
Low Shrinkage Matrix Resins
Warm Fog Dissipation Hypotheses

Lightweight Magnesium Dry Cell Batteries
Magnetic Wire Shift Register Boram

Controlled Contaminant Free Physiologic Atmosphere
High Speed Morse Telegraph Terminal
High Speed Rotating Electrical Machinery
High Strength Lightweight High Temperature
Integrated World Wide Topographic Concept
Internal Conversion Electron Spectroscopic Techniques
Low Energy Cosmic Gamma Rays
Mixed Radiation Absolute Calorimetric Dosimeter

Free Induction Nuclear Magnetic Resonance Flowmeter
Low Power Miniature Precision Frequency Synthesizer
Charged Particle Absolute Gravimeter
High Altitude Nuclear Detonations
High Altitude Pilot Helmets
High Altitude Pulmonary Edema
High Energy Nuclear Physics
High Energy Thermal Stimulation
High Fatigue Resistant Joints
High Force Cool Propellants
High Temperature Elastomeric Polymers
High Temperature High Stress
High Temperature Ionized Gases
Long Wave Infrared Sensors
Low Energy Nuclear Physics
Low Temperature Catalytic Oxidation
Marine Corps Medical Evacuation
Military Aircraft Open Cockpits
Narrow Beam Optical Radar
Resonant Pulse Parametric Oscillator
Small Engine Internal Aerodynamics
Stabilizing Light Sensitive Polymers
Thin Film Amorphous Semiconductors
Thin Film Piezoelectric Semiconductors
Ultra Violet Airborne Transmissometer
Upper Atmosphere Chemical Physics
Wide Angle Null Steering
Wide Band Object Camouflage

High Altitude Scientific Balloon Flight
High Performance Naval Weapons Systems
High Strength Armored Crew Seat
Integrated Ground Airborne Avionics System
Limited Function Integrated Avionics System
Wide Band Secure Crypto Equipment

High Temperature Warning System Solid State
Thin Film Solid State Facsimile Recording

High Temperature Extreme Pressure Greases
High Temperature Long Life Bearings
Lighter Weight Inflatable Life Boats
Closed Loop Primary Flight Control Systems
Colloidal Core Nuclear Reactor Rocket Engine
Dental Panographic X Ray Scanner System
Heavy Class Military Vehicle Propulsion Systems
High Performance Low Light Level Television
High Speed High Altitude Transport Aircraft
Highest Performance Low Light Level Tube
Low Altitude High Speed Flight Regime
Low Level Gamma Ray Flux Measurement
Microminiature Microwave Acoustic Surface Wave Amplifiers
Small Reserve Fluoboric Acid Poser Supplies
Ultra Reliable VHF FM Radio System

Electron Spin Lattice Interactions
Marine Corps Operational Logistics

Clear Air Radar Backscattering
High Altitude Balloon Instrumentation
High Strength Columbium Alloys
Pathogenic Micro Organism Aerosols
Rare Earth Cobalt Magnets
Rotary Wing Cockpit Instrumentation
Strategic Structures Vulnerability Hardening
X Band Microstrip Oscillator

Mobile Ocean Basing System Studies
Mobile Ocean Basing Systems Studies
Radiative Transport Weapons Effects Calculations
Retinal Burn Flashblindness Prediction Model
Single Mode CW Power Output

High Power CW Laser Radiation Studies
Low Altitude EMP Sensor Recording Systems
Thin Film Thermocouple Room Temperature Detector
Exploratory Model Maintenance Diagnostic Set
High Data Rate Secure Communications
High Pressure Impact Resistant Materials
High Sensitivity Field Warning System
Highest Peak Power Solid State
Lightweight Company Level Mortar System
Low Data Rate Global Communications
Low Dose Rate Gamma Exposure
Low Field Strength Electromagnetic Radiations
Solid State Devices Applied Research
Wide Band Gap Semiconducting Compounds
Wide Base Band Military Systems

High Performance Aircraft Thermal Control Systems
Solar Network Making Fixed Frequency Burst

Ceramic Metal Plastic Armor Composites
High Strength Beta Titanium Alloys
Three Candidate Meningococcal Meningitis Vaccines

Automated Tissue Cell Culture Control
Controlled Air Drop Cargo Systems
Controlled Air Drop Cargo System
Elevated Temperature Radiation Embrittlement Sensitivity
High Performance Aircraft EMP Testing
Military Space Vehicle Tracking Facilities
Solid State Micro Electronics Sciences
Variable Speed Constant Torque Turbine

High Quantum Efficiency Injection Luminescence
High Resolution Pulse Compression Radar
Primary System Water System Purification

Airborne Surveillance Target Acquisition Radar Techniques
Anti Tank Assault Air Defense System
Digital Data Acquisition Processing Display System
High Data Rate Laser Communications Systems
High Power Density Missile Power Sources
High Power Light Weight Power Generators
High Speed Landing Gear Track Facility
Variable Output Gas Generator Test Program

Atomic and Molecular Optical Parameters
Strategic and Tactical Military Variables

Aeroelastic and Thermoelastic Structural Loads
Antipersonnel and Anti Vehicular Mines
Closed and Partially Closed Atmospheres
Geophysical and Oceanographic Environmental Complexes
Heavy and Lightweight Transportable Equipment
Inner and Outer Solar Corona
Lethal and Incapacitating Chemical Agents
Linear and Digital Integrated Circuits
Linear and Nonlinear Mathematical Programming
Low and Extremely High Levels
Mathematical and Electrical Analog Models
Molecular and Atomic Spectroscopic Data
Monolithic and Mos Integrated Circuits
Normal and Abnormal Sensory System
Poisonous and Venomous Marine Animals
Subsonic and Supersonic Coaxial Streams
Tactical and Strategic Military Aircraft
Topographic and Military Geographic Support
Topographic and Military Geographic Information
Transportable and Ultra Transportable Equipment

Offensive and Defensive Chemical Systems Effectiveness
Rotary and Piston Combined Cycle Engine
Subsonic and Supersonic Slender Body Theory
Armored and Anti Armor Systems
Cold and High Elevation Regions
Military and Indigenous New Media
Open and Closed Iron Sights
Organic and Inorganic Radome Structures
Tropical and High Elevation Regions

Low and High Pressure Firing Tests
Mid and Long Range Strategic Forecasts
Rigid and High Temperature Resistant Materials

Advisory and Direct Support
Climatic and Operational Environments
Environmental and Operational Conditions
International and Organizational Conflict
Strategic and Operational Guidance

Diarrheal and Skin Diseases
Flame and Fragmentation Weapons
Regulatory and Stress Physiology
Utility and Cockpit Adaptability

Atmospheric and Radome Environment
Cellular and Organ Levels
Earthworking and Construction Equipment
Environmental and Endurance Testing
Gaseous and Particulate Materials
Mechanical and Oxidation Stability
Microbiological and Dosimetry Standards
Naval and Marcorps Teams
Photographic and Navigation Systems
Physical and Adhesive Properties
Positioning and Navigation System
Taylor and Helmholtz Effects
Warning and Detection Systems

Maneuvering and Drag Compensation Functions

Industrial and Government Proposals
Decontaminating and Dispensing Military Fuels

Automated and Computer Interfaced Microform Storage

Environmental and Shock Absorbing Properties
- Natural and Disturbed Atmospheric Environments
- Normal and Disturbed Ionospheric Conditions
- Quiet and Disturbed Geophysical Conditions
- Scientific and Management Advisory Committee
- Single and Counter Rotating Propellers

Microbiological and Radiation Dosimetry Standards
- Parasitic and Integral Armor Systems

Atmospheric and Background Light Conditions
- Ballistic and Reentry Flight Vehicles
- Biological and Liquid Metal Attack
- Electron and Ion Beam Techniques
- Normal and Emergency Flight Conditions
- Rarefied and Radiation Gas Dynamics
- Spectral and Time Signature Data
- Tactical and Air Defense Missions
- Technical and System Engineering Support
- Thermal and Flight Load Environments
- Thermodynamic and Transport Property Data

New Automated Captive Trajectory System

Direct Hydrocarbon Oxidation
- New Electromagnetic Detection
- New Organosilicon Lubricants
- New Synthetic Chemicals
Local National Labor Forces
New Flame Weapons Systems
New Freeze Drying Facilities
New Lightweight Armor Materials
New Miniature Oxygen Regulator

Complex Biomedical Problems
Complex Military Equipment
Complex Military Systems
Local Military Commands
New Acoustic Media
New Adaptive Technique
New Ballistic Data
New Biological Assays
New Biological Information
New Calorimetric Technique
New Ceramic Compositions
New Ceramic Materials
New Chemical Compounds
New Clinical Tests
New Computational Models
New Computational Techniques
New Dielectric Materials
New Digital Circuitry
New Digital Techniques
New Dynamic Stabilization
New Electrical Performance
New Electronic Functions
New Electronic Systems
New Epitaxial Films
New High Quality
New High Temperature
New Incendiary Agent
New Inorganic Compounds
New Inorganic Materials
New Magnetic Material
New Mathematical Aids
New Mathematical Theory
New Metallic Materials
New Microelectronic Circuits
New Military Environment
New Military Selection
New Nuclear Systems
New Optical Components
New Organic Structures
New Polymeric Materials
New Polyurethane Coating
New Precise Time
New Prime Systems
New Probabilistic Techniques
New Protective Equipment
New Stabilizing Additives
New Therapeutic Material
Operational Electromagnetic Compatibility
Operational Environmental Conditions
Operational Human Factors
Operational Hydraulic Oil
Operational Military Systems
Operational Tactical Settings
Quantitative Acoustic Reflection

New High Temperature Stable Macromolecules
New Wideband Log Periodic Antennas

New High Speed Excavating
New Infrared Transmitting Glasses
New Mental Standards Airmen
New Aerodynamic Stabilization Techniques
New Dental Equipment System
New Dynamic Strength Requirements
New Hybrid Computer Techniques
New Lightweight Aircraft Structures
New Lightweight Wind Systems
New Mathematical Problem Areas
New Military Health Problems
New Military Systems Equipments
New Nondestructive Testing Techniques
New Physical Conditioning Program
New Remote Control Units
New Self Dispersing Shapes
New Solid State Devices
New Supersonic Combustion Chamber
Operational Mobile Reconnaissance Facility
Operational Programmable Shock Strut
Operational Topographic Data Bank
New Continuous Tone Reproduction Materials
New Epoxy Dip Coating Systems
New High Pressure Gas Apparatus
New Parametric Surface Wave Amplifier
New Solid Film Bonding Techniques
New High Resolution Neutron Scattering Spectrometer
New High Resolution Phase Signature Radars
New Wide Temperature Range Base Stocks

Local Respiratory and Gastrointestinal Tract Immunity

New Antipersonnel and Antimateriel Dispenser Munition
New Atomic and Molecular Frequency Sources

New Domestic and Foreign Science

Local Bird Population
New CB Decontamination
New England Storms
New Insect Vibration

New Intrusion Detection System

Direct Blood Pressure
Expanded Armor Program
Lattice Vibration Spectra
Meteorological Balloon Systems
Meteorological Monograph Series
New Carborane Compounds
New Carborane Derivatives
New Career Orientation
New Construction Techniques
New Corrosion Inhibitors
New Dexsil Products
New Dust Palliatives
New Flutter Phenomena
New Flutter Prediction
New Instrumentation Techniques
New Irritant Compounds
New Man Machine
New Modulation Scheme
New Mothproofing Agents
New Piping Systems
New Radar Components
New Radar Indicator
New Transducer Devices
New Vibration Simulators
New Vtol Aircraft
New Weapons Systems
Real Battlefield Environment

New Aluminum Landing Mats
New Oxygen Breathing Mask
New Quartz Crystal Technique
Operational Vtol Aircraft System
Random Vibration Measurement Data

Complex Area
Complex Environment
Complex Environments
Complex Performance
Complex Plane
Complex Position
Complex Problems
Complex Structures
Complex Substances
Complex System
Complex Systems
Complex Vibrations
Direct Ascent
Direct Communication
Direct Effect
Direct Effects
Direct Fire
Direct Impact
Direct Measurement
Direct Method
Direct Navy
Direct Observation
Direct Potential
Direct Power

Direct Ranging
Direct Research
Direct Response
Direct Sounding
Direct Support
Direct Transformation
Direct Value
Direct Voice
Expanded Activity
Expanded Contract
Lattice Damage
Lattice Deformation
Lattice Spacing
Lattice Vibrations
Local Density
Local Level
Local Purchase
Meteorological Conditions
Meteorological Data
Meteorological Elements
Meteorological Equipment
Meteorological Measurement
Meteorological Prediction
Meteorological Processes
Meteorological Rocket
Meteorological Simulator
Meteorological Structures
Meteorological Support
Meteorological Variations
New Additives
New Agent
New Agents
New Air
New Aircraft
New Algorithm
New Antenna
New Applications
New Area
New Areas
New Center
New Class
New Codes
New Combat
New Components
New Compounds
New Computer
New Concept
New Conditions
New Container
New Contracts
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New Environments
New Equipment
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New Foundations
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New Generator
New Ground
New Growth
New Gun
New Heater
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New Information
New Installation
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New Laser
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New Materials
New Metal
New Method
New Methodology
New Munitions
New Navy
New Neutron
New Observations
New Officers
New Operations
New Pad
New Personnel
New Phenomenology
New Plasma
New Potentials
New Problems
New Processing
New Program
New Programs
New Project
New Properties
New Proposals
New Propulsion
New Prototype
New RADars
New Reactions
New Regions
New Requirements
New Research
New Rotation
New Seat
New Sequence
New Shelter
New Ships
New Sources
New Species
New Specification
New Start
New Starters
New Statistics
New Strain
New Structure
New Structures
New Studies
New Substances
New System
New Systems
New Target
New Targets
New Technique
New Techniques
New Test
New Tests
New Theories
New Theory
New Tool
New Vehicle
New Work
New Zones
Operational Activities
Operational Aircraft
Operational Applications
Operational Areas
Operational Bases
Operational Command
Operational Commands
Operational Condition
Operational Control
Operational Data
Operational Deficiencies
Operational Effectiveness
Operational Doctrine
Operational Effectiveness
Operational Effects
Operational Efficiency
Operational Environments
Operational Equipment
Operational Error
Operational Factors
Operational Functions
Operational Impact
Operational Job
Operational Logging
Operational Missions
Operational Model
Operational Munition
Operational Performance
Operational Personnel
Operational Planning
Operational Problems
Operational Range
Operational Readiness
Operational Reliability
Operational Requirements
Operational Restrictions
Operational Selection
Operational Settings
Operational Speed
Operational Support
Operational System
Operational Test
Operational Testing
Operational Tests
Organizational Problems
Organizational Requirements
Organizational Set
Organizational Structure
Organizational Structures
Organizational Subsystems
Quantitative Calculations
Quantitative Data
Quantitative Description
Quantitative Effects
Quantitative Information
Quantitative Interactions
Quantitative Reliability
Quantitative Safety
Quantitative Solution
Quantitative Solutions
Quantitative Techniques
Random Excitation
Random Processes
Real Problems
Real Structures
Real Time
Direct Fire Antitank Guided Missiles

New Heat Resistant Explosive Compounds
New Interference Free Field Method
New Polymer Pyrotechnic Fuel Mixtures

Collision Transport Integrals
Direct Air Blast
Direct Fire Ammunition
New Antiradiation Chemicals
New Polymer Binders
New Transmission Seal
Real Time Computations

Complex Aerospace Communications
Complex Computer Processing
Complex Computer Programs
Complex Data Bases
Complex Energy Interactions
Complex Flow Field
Complex Flow Fields
Complex Information Processing
Complex Problem Solving
Complex Threat Environments
Complex Training Problems
Direct Energy Conversion
Direct Exposure Tests
Direct Mode Operation
Direct Ranging Method
Local Command Resources
Local Heating Effect
Local Radiation Belts
Meteorological Data Requirements
Meteorological Information Criteria
Meteorological Rocket Concept
Meteorological Rocket Program
New Active Exchangers
New Aircraft Proposals
New Alloy Materials
New Amplification Techniques
New Communications Concept
New Computer Programs
New Computer System
New Control Techniques
New Data Cards
New Drug Applications
New Emplacement Holes
New Energy Absorption
New Engine Cycles
New Engineering Material
New Explosive Fillers
New Feeding Requirements
New Field Studies
New Fire Suppression
New Gun System
New Imaging Techniques
New Kill Criteria
New Laser Systems
New Materiel Requirements
New Measurement Techniques
New Membrane Materials
New Navy Contracts
New Nonmetallic Materials
New Performance Area
New Personnel Management
New Plastic Frame
New Power Sources
New Preservation Techniques
New Probe Measurement
New Problem Areas
New Project Area
New Propellant Systems
New Recoil Mechanisms
New Reconnaissance Equipment
New Reconnaissance Systems
New Research Program
New Safety Devices
New Sensor Information
New Sensor Systems
New Shock Tube
New Simulation Problems
New Storage Materials
New Systems Simulation
New Tank Materials
New Technique Areas
New Test Series
New Test Techniques
New Testing Techniques
New Transmission Techniques
New Transmitter Techniques
New Vehicle Control
New Wave Classification
New Weapon Configurations
New Weapon System
New Weapon Systems
New York University
Operational Aerospace Systems
Operational Failure Data
Operational Flight Environments
Operational Interference Problems
Operational Performance Efficiency
Operational Personnel Tests
Operational Problem Areas
Operational Research Techniques
Operational Satellite Altitudes
Operational Satellite Systems
Operational System Efficiency
Operational Temperature Range
Operational Weather Forecasts
Organizational Field Equipment
Quantitative Performance Data
Quantitative Satellite Tests
Random Access Method
Random Gust Loads
Random Wave Studies
Real Air Force
Real Flight Loads
Real Gas Effects
Real Life Targets
Real Time Acquisition
Real Time Context
Real Time Data
Real Time Display
Real Time Identification
Real Time Prediction
Real Time Processing
Real Time Signal
Real World Conditions
Real World Environments

New Metal Phosphinate Polymers
New Power Transmission Fluids
New Shed Light Sensors
New Ship Concept hydrodynamics
New Sounding System Sensors
Operational Air Force Satellites

New Pulse Code Modulation Multiplexer
Complex Energy Interaction Mechanisms
Direct Energy Conversion Processes
Direct Energy Conversion Techniques
Local Radio Distribution Systems
Meteorological Data Sounding System
Meteorological Observation System Studies
New Aerosol Field Samplers
New Air Force Systems
New Airframe Reliability Criteria
New Fire Control Systems
New Flight Load Survey
New Liquid Crystal Systems
New Liquid Crystalline Compounds
New Power Conversion Systems
New Power Supply Systems
New Signal Processing Technique
New Sound System Area
New Weapon System Procurements
Operational Air Force Commands
Operational Earth Space Communications
Quantitative Static Ground Tests
Real Time Computer Control
Real Time Computer Processing
Real Time Information System
Real Time Prediction Radiation
Real Time Reconnaissance Displays

New Satellite Velocity Mass Spectrometer
New Turbine Guide Vane Material
Real Time Data Processing Work

New Air Defense Computer Simulation Models

Fiberglass Reinforced Plastic Tail Rotor Assembly

Arthropod Borne Virus Diseases
Man Sanitary Waste Disposal
Silicon Schottky Barrier Photodiodes
CIG Lighting Team Communications
Man Tactical Support Aircraft
Michigan International Data Archives
Passive High Flux Neutron
Princeton Dynamic Model Track
SI Schottky Barrier Detectors
Stress Acoustic Surface Wave
Texas Social Behavior Inventory
Thunderstorm Electrical Charge Distributions
UHF Unfurlable Satellite Antenna
VLF Elf Propagation Codes
VLF LF Reflection Coefficients

Battalion Close Support Weapon System
Iron Double Focusing Beta Spectrometer
Vtol Low Speed Flight Dynamics

Man Portable and Avionics Equipments

Ardis Operational Subsystems

Artillery Weapons Applied Research
CW BW Defensive Operations
CW BW Medical Defense
Rain Erosion Resistant Materials

Diver Helium Speech Unscrambler

Barium Strontium Titanate Single Crystals

Hydrogen Oxygen Fuel Cell Plant
Balloon Borne Sensors
Passive Human Monitor
Vacuum Resistant Lubricants

Corrosion Preventive Compounds
Lightning Warning Set
Radar Doppler Shifts

Oscillator Strengths
Payload Ejection
Silicon Carbide

Epidemic Typhus Rickettsia
Skin Friction Drag
Stress Corrosion Cracking

Bond Dissociation Energies
Diver Speech Communications
Nucleation Condensation Processes

ASW Sonar Target Simulation
Fallout Debris Cloud Formation
Sand Dust Water Separator

Calculus of Variations
Degradation of Rubber
Turbulence of Plasma

Beach Jumper
CAI Techniques
Defoliation Activities

Eye Burn Hazards
Firepower Denial Neutralization
GAAS Laser Diodes

Hafnium Base Alloy
Impurity Defect Interactions
Kansas State University
Fallout Patterns
Grinding Parameters
Growing Number
History Variables
Moisture Parameters
Personality Variables
Seeding Patterns
Sleep Patterns
Speech Patterns

Additive Effects Microbial Growth
Aluminum Alloy Structural Shapes
Cannon Launched Guided Munition
Cannon Launched Guided Munitions
Drag Reduction Polymeric Additives
Elastomer Sheet Antifouling Coatings
GE Area Illuminating Rocket
Indium Antimonide Schottky Barriers
Terrain Avoidance Warning System
Titan Vehicle Electrostatic Environment

Grid Wind Tunnel Computer Technique
Rotorcraft Flight Maneuvering Computer Program

Albacore Polymer Additive Program
Aquanaut Life History Questionnaire
Diving Failure Detection System
Fleets Shock Hardening Program
Magnesium Aluminate Spinel Display
Quartz Crystal Humidity Sensor
Sodium Chlorate Oxygen Generators
Terrain Vehicle Man System

Aluminum Wood Elastomer Composite Inserts
Artillery Simulator Artillery Simulator Program

Blood Flow Patterns

Artillery Fire Control Applied Research
CW Operation Avalanche Oscillators
Titanium Alloy Airframe Joints

Navigation Guidance Computer Memory Devices
Sediment Shear Wave Sound Speed

Environment Controlled Delayed Elastic Effects
Mode Linear Partial Differential Equation
Ultrasonic Electron Nuclear Double Resonance

Explosion Resistant Hydraulic Fluids
Fire Resistant Phenolic Foams
Weight Protective Flexible Shelters

Active Stripline Phased Arrays
Aircraft Mechanical Hydraulic Subsystems
Aircraft Mechanical Hydraulic Equipment
Aircrew Environmental Protective Systems
Broadband Tuning High Power
Control Chronic Respiratory Disease
Disseminating Military Geographic Data
Exhibits Very Brittle Behavior
Heat Resistant Inorganic Materials
Radiation Hardened Electronic Devices
Radiation Resistant Rugged Reliable
Radiation Resistant Solar Cells
Reliable Fixed Tuned Circuits
Reliable Hydraulic Mechanical Equipment
Standard Finite Difference Techniques
Testing Modular Medical Units
Voice Excited Formant Tracker
Wind Tunnel Free Flight
Wind Tunnel Magnus Balance
World Wide Climatological Data
World Wide Environmental Requirements
World Wide Military Command
World Wide Military Operations
World Wide Precise Time

63
Control Nuclear Electromagnetic Blackout Phenomena
Exhibit Extremely Fast Diode Behavior
Flight Maneuvering Digital Computer Program
Prototype Centralized Automatic Test System
Radiation Resistant Solid State Materials
Rocket Borne Chemical Release Tests
Stol Utility Fixed Wing Airplane
World Wide Environmental Health Conditions

Fleet Chemical Biological Warfare Defense Studies
Point Detonating Proximity Point Initiating Base
Prototype Self Luminous Vehicle Instrument Dials
Wind Tunnel Magnus Effect Test Models

Army Wide Operational Chemical Information System

Determination Small Arms Weapons

Aircraft Arresting Hook Installation
Army Small Arms Program
Army Small Arms Requirements
Computer Interfaced Microform Storage
Disturbed Polar Ionosphere Studies
Instrument Pilot Instructors School
Level Warm Fog Model
Processing Red Blood Cells
Prototype Photochromic Goggle System
Rocket Borne VLF Receivers
Roll Bonded Titanium Panels
Transmission Electron Microscopy Studies
Voice Excited Vocoder Operations

Frequency Modulated Phase Locked Digital Synthesizer

Army Long Range Technological Forecast
Forecasting Long Range Military Requirements
Forming Ceramic Metal Ceramic Structures
Glass Reinforced Plastic Structural Rod
Potential Deep Submergence Structural Material
Propellant Actuated Devices Applied Research
Army Marine Craft Modernization  
Candidate Ablative Polymer Composites  
Efficiency Schottky Barrier Diodes  
Metal Bonded Diboride Composites  
Potential Solid State Lasers  
Ship Amphibious Field Medicine  
Test Remote Terminal Query  
Turbine Powered Pipeline Pumps

Air Mobile Aircraft Refueling System  
Composite Ceramic Metal Armor Area  
Prototype Buoyant Body Armor Assembly  
Support Worldwide Army Construction Requirements  
Watch Standing Monitoring Sonar Displays

Vehicle Hydraulic System Maintenance Diagnostic Sets

Army Offensive and Defensive Weapons  
Tank Primary and Secondary Armament

Arc Second and Automatic Position Read  
Army Topographic and Geodetic Systems Requirements  
Field Medical and Dental Treatment Facilities

Soil Applied and Growth

Contract Clinical and Laboratory Research  
Fluid Dynamic and Control Systems  
Hazard Warning and Target Acquisition  
Injector Mixing and Ignition Systems  
Motor Drive and Transport System  
Processing Geodetic and Mapping Data  
Radio Astronomical and Satellite Studies  
Shot Window and Satellite Damage

Wind Tunnel and Range Test Facilities
Army Direct Aerial Fire Support

Army Direct Aerial Fire Support Aircraft

Aircraft Operational Restrictions
Army Operational Requirements
Caliber Direct Fire
Combat Operational Environment
Disseminating Meteorological Data
Engine Operational Problems
Fleet Operational Conditions
Fleet Operational Forces
Logistics Organizational Structures
Research Meteorological Teams
Spin Lattice Relaxation Problems
Shed New Light
Spin Lattice Relaxation Time
Standard Meteorological Equipment
Support Operational Commands
System Operational Failures
System Operational Processes

Spin Lattice Relaxation Time
Support Meteorological Field Studies
Support New Communication Equipment

Laser Scintillation Atmospheric Turbulence
Liquid Helium Nucleate Boiling

Air Leakage Sealing Mechanisms
Aircar Eye Protective Equipment
Flash Blindness Protective Devices
Ground Crew Technical Training
Helicopter Downwash Mixing Technique
Tank Cannon Applied Research
ZNAZN

FM CW High Resolution Radar

ZNBN

Field Artillery Direct Support Cannon

ZNNZ

Class LST Marriage Gear
Composite CDS Quartz Resonators
Ground MTI Radar Techniques
Phase Synthesis Taper Techniques
Plasma Chromatography Detection System
Polymer Additive Drag Reduction
Shock Hardening Ordnance Equipment

ZZAN

Air Force Biomedical Scientists
Air Force Clinical Medicine
Air Force Nuclear Weapons
Light Weight Doppler Sensors
Materiel Support Southeast Asia
Polymer Solutions Inhibit Cavitation
Problem Studies Integrating Ammunition

ZZANZ

Army Engineer Nuclear Cratering Group
Army World Wide Overseas Problems
Flight Test Auxiliary Cooling System
Pulse Code Modulated Multiplexer Equipment

ZZAZN

Dual Hardness Kinetic Energy Ammunition
Millimeter Wave Solar Temperature Maps

ZZAZZ

Air Force Close Air Support
Air Force Electronic Systems Equipments
Air Force Global Weather Central
Air Force Human Resources Laboratory
Air Force Pilot Factors Program
Ball Screw Hydropneumatic Suspension System
Compound Semiconductor X Band Receiver
Gun Launched Guided Projectile Structures
Lead Sulfide Infrared Detector Materials
Model Field Medical Laboratory System
Air Force Close Air Support Aircraft
Air Force Unmanned Radiation Satellite Program
Field Army Forward Area Air Defense

Aircraft Systems Operational Safety Requirements

Integral Rocket Battalion Ammunition

Air Defense Guns Systems
Air Force Armament Laboratory
Air Force Vtol Aircraft
Air Force Weapons Laboratory
Air Force Weapons Systems
Air Pressure Casting Machine
Aircraft Impact Injury Prevention
Arsenal Laser Physics Research
Combat Vehicle Crew Sizes
Combat Vehicle Weapons Systems
Draft Army Artillery Program
Dual Beam Radar Returns
Fire Control Radar Systems
Flight Deck Eye Protection
Guide System Software Acquisition
Host Pathogen Biocide Interactions
Laboratory Animal Housing Modules
Land Combat Weapons Effectiveness
Laser Performance Decrement Studies
Light Water Carbon Dioxide
Novel Air Weapons Launching
Plan Cut Foliage Preservation
Radio Relay Retransmission Problems
Range Speed Payload Potential
Reentry Vehicle Vibration Predictions
Room Temperature Copper Cavities
Threat Level EMP Simulator
Time Division Multiplex Equipment
Traffic Ship Navigation Aids
Transport Aircraft Crew Utilization
Vapor Space Corrosion Inhibitors
Vehicle Performance Terrain Relations
Weapon Test Vulnerability Problem
<table>
<thead>
<tr>
<th>Code</th>
<th>Num</th>
<th>Description</th>
<th>Details</th>
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<td>1</td>
<td>forward deployed NATO airborne moving target</td>
<td>of forward deployed NATO general purpose forces with to give airborne moving target indicating (MTI) radaring systems for</td>
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<td>exact lower confidence</td>
<td>an exact lower confidence bound for the+W+ flag at the ninth international ionized gas conference tests of modular x-ray unit</td>
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<td>extremely low power</td>
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<td>1</td>
<td>international ionized gas</td>
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<td>1</td>
<td>modular x-ray</td>
<td>A single integrated engineering development effort will be</td>
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<td>AAZ</td>
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<td>portable long base</td>
<td>53x civil engineering services by contract:</td>
</tr>
<tr>
<td>AAZZ</td>
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<td>single integrated engineering</td>
<td>A coaxial dense plasma focus device is being assembled</td>
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<tr>
<td>ANZ</td>
<td>3</td>
<td>consumable rockets launched</td>
<td>the application of consumable rockets launched from ocean buoys</td>
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<tr>
<td>ANZ</td>
<td>3</td>
<td>tropical oceans lead</td>
<td>studies over tropical oceans lead to the conclusion</td>
</tr>
<tr>
<td>AZZ</td>
<td>3</td>
<td>transonic speeds lead</td>
<td>airflow at transonic speeds lead to airfoil sertim</td>
</tr>
<tr>
<td>AZZZ</td>
<td>3</td>
<td>high speed vehicle flying</td>
<td>particles collected by high speed vehicle flying</td>
</tr>
<tr>
<td>A+ZZ</td>
<td>3</td>
<td>filling gaps</td>
<td>through rain will be updated by replacing new data for old and</td>
</tr>
<tr>
<td>NAZ</td>
<td>3</td>
<td>monitor cardiovascular response</td>
<td>filling gaps developed instrumentation to monitor cardiovascular</td>
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<tr>
<td>NAZ</td>
<td>3</td>
<td>monitor environmental factors</td>
<td>response to various Monitor environmental factors affecting acoustic</td>
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<tr>
<td>NAZ</td>
<td>3</td>
<td>stress incapacitating agents</td>
<td>transmission field warming system which stress incapacitating</td>
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<tr>
<td>NAZ</td>
<td>3</td>
<td>stress inorganic materials</td>
<td>agents and to efforts will stress inorganic materials for</td>
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<td>NN</td>
<td>3</td>
<td>soldiers wounded</td>
<td>the care of soldiers wounded on the battlefield</td>
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<tr>
<td>AAZ</td>
<td>4</td>
<td>classical x-ray</td>
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<tr>
<td>AAZ</td>
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<td>fast compact reliable</td>
<td>through fast, compact, reliable and flexible processors</td>
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<tr>
<td>AAZ</td>
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<td>marine integrated fire</td>
<td>(3) marine integrated fire and support;</td>
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<td>Code</td>
<td>Value</td>
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<td>AAZ</td>
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<td>marine integrated personnel parallel extremely reliable processors configured for utility, heavy lift, and surveillance missions merged into variable single seat and multi-crew configurations as the support of amphibious overseas and remote area operations and the other with combined airblast and direct induced effects. Mixed zirconium and whisking graphite fibers to electronic ports applied research and engineering effort on truck transmission matching including automatic transmission in the event nuclear weapons are used on in the education and training technical domain maintain design guide current as the state-of-the-art advance that effective engage targets visible to the a result of test operations at test command DASA; define effects micro wave radiation on central nervous systems, and will identify problems problem areas, refine vehicle performance-soil another vehicle performance-terrain relations. The microbiological, nutritional, biochemical and chemical factors and elastomeric sphere filled tire for increased chemical, biochemical, physical and microbiological limitations.</td>
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<td>AAZ</td>
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<td>variable single seat</td>
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<td>AAZ</td>
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<td>amphibious overseas combined airblast</td>
<td></td>
</tr>
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<td>AN</td>
<td>4</td>
<td>mixed zirconium</td>
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<td>electronic ports applied research</td>
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<td>truck transmission matching</td>
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<td>ZAZ</td>
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<td>5</td>
<td>training technical domain guide current</td>
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<td>targets visible test command effects micro wave radiation</td>
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<td>problems problem areas vehicle performance soil</td>
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<td>the microbiological, nutritional, biochemical elastomeric sphere filled chemical biochemical</td>
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<tr>
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combined pitch
combined attitude
combined sound
combined work
empirically aid
increasingly active
physiological biochemical

manual automatic control
seismic mineral phase
slender high velocity
solid gas
mid high intensity warfare
ceramic metal
least operation
lightweight reliable
sensitive quantum
technical domain atmospheric

study of combined pitch and yaw oscillations
methods of providing combined attitude sensing and
missile control
the problem of combined sound, high temperature
environment simulation
the combined work has led to a
to empirically aid in developing alternate ...
They will become increasingly active in the
through physiological, biochemical and chemical pathological
investigations

; manual/automatic control application
mineral properties (seismic, mineral phase, electrical) at
of a slender high velocity, oblique-angle, water-entry
will be
, solid/solid and solid/gas equilibria
airmobility in mid-high intensity warfare in Europe
and ceramic metal combinations
and not least, operation in adverse
prototypes of lightweight, reliable, high performance
cryogenic coolers.
to evolve sensitive quantum-electronic, parametation
other low-noise receivers
in the technical domain-atmospheric environment

The National Bureau of Standards
state-of-the-art surveys, designs data
University of Arizona contract F33615-70-C-1007 becomes
The University of Kentucky contract will be considered for
by the Republic of Korea army.
at the University of Tennessee space institute,
University of Virginia contract F33615-69C-1048 becomes
design of an angle-of-attack control for sounding
rockets
based on Department of Defense guidance concerning the
, circle of error probable
demolition kit catering detection techniques radar

In the development of catering detection techniques radar and aircraft data
"Introduction of terrain-vehicle systems" University of Michigan press
such as holography and computers magnetohydrodynamics
and
by this method graphite was converted to
for measuring radiation, temperature humidity, density, composition
In addition work will proceed on
within the molecular energy can be redistributed
under these sub-projects research will be
continue selected material handling studies documentation studies

methods of destroying classified material will
present physiological hazards form incapacitating Naval personnel

manipulate factual data

One application of mixing helium and oxygen in

inhibit learning

one method of absorbing heat will be very effective

to study means of propagating electromagnetic waves

mixing helium

this method of absorbing heat will be very effective

mounting turbulence sensors

that item by type classified standard A

classified standard

means of efficiently generating signals at micro wave,
<table>
<thead>
<tr>
<th>Code</th>
<th>Number</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAZ</td>
<td>11</td>
<td>electro optical ultraviolet</td>
<td>objects with extremely high radio, x-ray, ultraviolet, or infrared flux...</td>
</tr>
<tr>
<td>AAZ</td>
<td>11</td>
<td>extremely high radio</td>
<td>improved efficiency, small size, light weight long life, greater reliability</td>
</tr>
<tr>
<td>AAZ</td>
<td>11</td>
<td>light weight long life</td>
<td>a morning belt downward looking infrared display for sights include optical reflection luminescent, open and closed iron sights.</td>
</tr>
<tr>
<td>AAZ</td>
<td>11</td>
<td>looking infrared display</td>
<td>such international groups as quadripartite, NATO, SEATO, MWDA, etc.</td>
</tr>
<tr>
<td>AAZ</td>
<td>11</td>
<td>optical reflection luminescent</td>
<td>a need to detect, in real time, alpha beta, gamma neutron and x-ray radiation</td>
</tr>
<tr>
<td>AN</td>
<td>11</td>
<td>quadripartite NATO</td>
<td>(3) electron, neutron, x-ray and molecular beam diffraction</td>
</tr>
<tr>
<td>AZ</td>
<td>11</td>
<td>alpha beta</td>
<td>in injection, mixing ignition and combustion in</td>
</tr>
<tr>
<td>AZ</td>
<td>11</td>
<td>electron neutron</td>
<td>A multiple phase, 30 month, advanced development program is...</td>
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<tr>
<td>AZ</td>
<td>11</td>
<td>mixing ignition</td>
<td>of new carborane compounds</td>
</tr>
<tr>
<td>AZ</td>
<td>11</td>
<td>multiple phase</td>
<td>the field of a magnet off its axis has been</td>
</tr>
<tr>
<td>BN</td>
<td>12</td>
<td>new carborane</td>
<td>an uncontrolled 90 degree skid off the pavement</td>
</tr>
<tr>
<td>ZZ</td>
<td>13</td>
<td>magnet off</td>
<td></td>
</tr>
<tr>
<td>ZZ</td>
<td>13</td>
<td>skid off</td>
<td></td>
</tr>
</tbody>
</table>
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