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по профилю «Управление процессами технической эксплуатации бортового оборудования воздушных судов»

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Оглавление

Unit 1. Wired for Success Ensuring Aircraft Wiring Integrity

Exercise 1. Express your ideas on the following:
Wiring or conductors are just one part of an aircraft's electrical interconnection system.

Exercise 2. Read the transcription.

əˈkjuːmjʊleɪtɪd ˈdæmɪʤ	ˈpaʊə ˌdɪstrɪˈbjuːʃən ˈpænlz
kəˈmɜːʃəl ˈeərəˌspeɪs ˈɪndəstri	ˈfeɪljə-friː ˈɒpəreɪtɪŋ ˈpɪərɪədz
ˈləʊə səsˈteɪnmənt kɒsts	straɪdz
ədˈvɑːnst ˌdaɪəgˈnɒstɪks	tɛkˈniːks
ˈmɛkənɪzmz	ˈhaɪˌlaɪts
ˈseɪfgɑːd	ɪˈlɛktrɪkəl
ˈkɛmɪkəl	ˈθɜːməl

Exercise 3. Read and translate the text.

This system includes connectors, relays, circuit breakers, power distribution panels, and generators. Degraded performance of one of these components or combinations thereof, can occur from accumulated damage. While damage has numerous sources, most are caused by long-term exposure to the surrounding environment as a result of chemical, thermal, electrical, and mechanical stresses. Installation and maintenance practices can also induce stress. The term stress as it is used here refers not necessarily to a physical or mechanical stress, but rather to any factor within the operating environment of a system that contributes to degrading that system, and thus depleting it of remaining service life. Most systems experience multiple "stresses" during the course of their use. For legacy (long-term inventory) aircraft, aging wiring systems have been plagued by intermittent failures that are difficult to document and result in unscheduled maintenance.

Managing aging wiring systems has been primarily reactive, since few tools exist for employing proactive approaches. This article highlights some recent events that have resulted in an increased emphasis on wiring interconnection and power distribution, both of which are considered highly critical to the safe and successful operation of modern aircraft and space vehicles. It also looks at the emergence of proactive approaches designed to safeguard wiring system performance.

Recent cooperative efforts by government and industry organizations have created new opportunities for significant improvements in wire system integrity and the use of more proactive approaches. This is being accomplished through the use

of more robust materials, greater understanding of failure mechanisms, the successful application of advanced computer modeling techniques, advanced protection devices, new inspection tools, and advanced diagnostics. Properly applied, these new technologies and tools are expected to result in wiring systems with long-term, failure-free operating periods and lower sustainment costs; significant strides that will benefit both the military and the commercial aerospace industry.

Exercise 4. Give the Russian equivalents for the following words and word combinations and learn them.

Connectors; accumulated damage; failure-free operating periods; generators; relays; power distribution panels; circuit breakers; commercial aerospace industry; lower sustainment costs; advanced diagnostics; chemical, thermal, electrical, and mechanical stresses; to highlight; to safeguard.

Exercise 5. Answer the following questions:

1. From what can degraded performance occur?
2. Explain the meaning of "accumulated damage".
3. Explain the meaning of "stress".
4. What are the peculiarities of managing aging wiring systems?

Exercise 6. Put 5 types of questions to each sentence.

Recent cooperative efforts by government and industry organizations have created new opportunities for significant improvements in wire system integrity and the use of more proactive approaches.

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Exercise 7. Analise the structure of the sentences and transfer the sentences into Active Voice.

The term stress as it is used here refers not necessarily to a physical or mechanical stress, but rather to any factor within the operating environment of a system that contributes to degrading that system, and thus depleting it of remaining service life.

Aging wiring systems have been plagued by intermittent failures.

Exercise 8. Put the words in the correct order.

on wiring interconnection; an increased emphasis; both of which; of modern aircraft; some recent events; this paper; and power distribution; highly critical; and space vehicles; raises; that have resulted in**;** are considered; to the safe and successful operation**.**

Most; as a result of; has numerous sources; long-term exposure; damage; are caused by; to the surrounding environment; chemical, thermal, electrical, and mechanical stresses.

Exercise 9. Render the text.

Exercise 10. Open the brackets, put the verbs in the correct tense form.

In July 1998, the Federal Aviation Administration (FAA) (to issue) a report titled, "FAA Aging Transport Non-Structural Systems Plan". The report (to address) concerns raised by the White House Commission on Aviation Safety and Security, which (to conclude) that existing procedures, directives, quality assurance, and inspections might not be sufficient in preventing safety-related problems. These problems, the commission asserted, can (to result) from corrosion and other deteriorating effects to non-structural components on aging aircraft, such as the wiring system.

In response to the public attention being drawn to commercial aircraft wiring issues, such as those that (to result) in the TWA 800 and Swiss Air 111 crashes, a White House Interagency Working Group (IWG) (to form) in June 2000 to examine policy, programs, investment priorities, and direction across the Executive Branch. Findings by the IWG (to publish) in an interagency report titled, "Review of Federal Programs for Wire System Safety," issued in November 2000. This report (to highlight) not only the importance of wiring systems but concern for their aging.

Exercise 11. Open the brackets, put the verbs in the correct tense form.

Similar to commercial industry, the Air Force typically directly (not to report) wiring as a cause for maintenance actions. In many cases, a wiring maintenance action (to list) as a minor repair or a subsystem failure (i.e. radar or radio). As a result, cursory computer (to search) of Air Force maintenance data tend to infer wiring (to be) an infrequent maintenance item.

The Air Force Research Laboratory Materials and Manufacturing Directorate (AFRL/ML) (to initiate) an aging wiring program to address sustainment issues related to wiring systems. This program (to establish) in response to continuing extensions in the operational life of several aircraft. Given limited budgets, the Air Force, and more specifically AFRL/ML, (to collaborate) with the Navy, Army, FAA, and the National Aeronautics and Space Administration (NASA) to optimize and share the benefits of the research program. This multi-agency group (to challenge) aerospace companies to address wiring system issues. The group also (to collaborate) with other principal industry sectors, such as housing, automobiles, consumer products, and nuclear power plants.

Electrical wire distribution in aircraft (to become) more critical as aircraft performance and flight stability (to become) more dependent on avionics. This (to

increase) emphasis and reliance on electronic systems for modern aerospace vehicles (to elevate) wiring to the level of a major safety-of-flight issue. An increasing number of aerospace systems now (to use) fly-by-wire technology and avionics, both of which (to rely) extensively on electrical wiring, to control and manage many of the critical onboard subsystems.

According to a recent AFRL study on Air Force mishaps, no less than 43 percent of the mishaps related to electrical systems (to be) due to connectors and wiring problems. The types of failures identified in this study (to include) hydraulic and fuel fires initiated by electrical arcing or degraded interconnections, which in turn (to cause) malfunctions in flight control circuits and other critical systems. Wiring-related problems, in fact, (to comprise) more than 271 separate incidents over an investigated 10-year period. Wiring conductors and connectors (to make) up 43% of the population.

Exercise 12. What do these abbreviations stand for?
AFRL, FAA, AFRL/ML, NASA, IWG

Exercise 13. Render the text in English.

Электропроводка самолета – это не просто удобство, а сложная система. Отказ ключевых компонентов этой системы может вывести самолет из строя или поставить под угрозу способность экипажа эффективно управлять им. Все системы электропроводки подвержены старению в течение срока службы. Старение приводит к постепенному ухудшению физических свойств и характеристик с течением времени. Важно отметить, что этот процесс может значительно ускориться при частом обращении с электропроводкой или при проведении технического обслуживания на электропроводке или рядом с ней. Отказы электропроводки часто проявляются в виде обрыва проводников или повреждения изоляции, что может нарушить электротехнические повреждения, которые могут возникнуть в результате различных воздействий.

Несколько транспортных самолетов столкнулись с частичной потерей питания от сети постоянного тока в полете, когда сработали первичные автоматические выключатели сети постоянного тока. Это привело к отказу многочисленных приборов и критических систем. Был проведен обширный анализ отказов, который показал, что отказы были связаны с монтажными проблемами, перепадами электроэнергии, ухудшением качества материалов и производственными отклонениями в нескольких компонентах системы проводки. При перегреве изоляция, покрывающая два соединения, расплавилась. Покрытие полностью разрушилось под воздействием высокой температуры (более 800°C).

В исследованном самолете система питания от сети постоянного тока распределялась через две панели автоматических выключателей и питалась от двух каналов (правого и левого генераторов). Эти каналы были связаны между собой, так что в случае отказа одной стороны другая обеспечивала питание обеих. Наличие шинного выключателя позволяло отключению одного

выключателя распространяться на противоположный выключатель. При таком сценарии оставшийся выключатель нес нагрузку обеих ветвей (которая превышала номинал выключателя). Это привело к тому, что выключатель также отключился. В результате произошло частичное отключение питания от источника постоянного тока и всей авионики, управляемой этим источником питания.

Exercise 14. Read and translate the text. Give the short summary.

The 40-ampere breaker terminated in a 12-gage size wire. The investigators discovered that breakers removed from D.C. power loss incidents failed the minimum ultimate trip test (115 percent overload for at least one hour) for a new breaker. In at least one case, the arcing damage was severe and the breaker reached temperatures that could cause a catastrophic failure (163°C). The 12-gage wiring connected to the 40-ampere breaker, in fact, altered the trip characteristic of the thermally activated device. This is because the wiring functions as a heat sink for the internal signals and lead to arcing. As shown fluctuations, materials degradation, and manufacturing variations in several wiring system components.

In the aircraft examined, the D.C. power system was distributed through two circuit breaker panels and powered by two channels (right and left generators). These channels were tied together, so that if one side failed the other would provide power to both. The presence of the bus tiebreaker allowed the tripping of one breaker to propagate to the opposite breaker. Under this scenario, the remaining breaker carried the load of both branches (which exceeded the rating of the breaker). This increased breaker to also trip. The result was loss of partial D.C. power and all avionics controlled by this power source.

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In this aircraft, a 12-gage wire was connected to the 40ampere breaker using a ring terminal. Prior to entering the circuit breaker panel, a butt splice was used to reduce a 10-gage wire down to a 12-gage wire size. The butt splices and ring terminals associated with the essential busses were overheating. This was due to high resistance, primarily at the 12-gage wire connection. The application of load currents showed there was excessive heating at the crimp connections for terminations removed from the aircraft. The investigating team also discovered that a gas-tight interface was not being formed between the wire and crimp terminal. This was due to the use of wire conductors with diameters below minimum specification and the type of tool used to form the crimp. Testing revealed the crimp tool used in the field (different from the butt splice manufacturer’s tool) produced marginal or

inadequate crimps on 12-gage butt splices and ring terminals. The recommended approach to eliminate the re-occurring electrical failures was to replace the butt splices with continuous 10-gage wiring terminated with crimped environmental ring terminals. The team also recommended that the degraded 40-ampere breakers be replaced.

Exercise 15. Give the Russian equivalents for the following words and word combinations and learn them.

The 40-ampere breaker, minimum ultimate trip test, arcing damage, thermally activated device, a heat sink, fluctuations, materials degradation, circuit breaker panel, bus tiebreaker, to propagate, a butt splice, ring terminals, the essential busses, at the crimp connections, a gas-tight interface, to eliminate the re-occurring electrical failures, with crimped environmental ring terminals.

Exercise 16. Open the brackets, put the verbs in the correct tense form, voice and translate the text.

This example (to serve) as an excellent illustration as to why wiring distribution (to need/ to treat) as a complete system. In this case, the overall electrical failure (to be) due to the interaction of the aircraft current loads, terminations, wiring, connectors, and circuit breakers. Interestingly, the load on each component by itself (not to be) sufficient to cause an overall electrical failure, and the maintenance community (to consider) periodic replacement of terminations and circuit breakers a standard practice. The engineering community (to be) unaware of the failures, due to the ineffective data reporting process. Both communities (to be) also unaware of the subtle changes that (to occur) in the wire and crimp tool or the increased avionics loading that (to occur) over a period of several years.

Many aircraft accidents (can /trace) to how an aircrew responds to a system failure. In the above case, the aircrews (to be able) successfully land the affected aircraft. While no aircraft (to lose), several missions (to be abort) and considerable aircraft downtime and cost (to be require) to implement the recommended fixes. Many of the current maintenance approaches today (to be) reactive (such as the example above) and therefore only (to address) wiring when a failure (can/resolve). Once the root cause of the electrical failures (to identify), an effective solution (can/ develop). The example also (to demonstrate) how components in a wiring system (to be) mutually dependent on each other.

In another example, an Air Force field study on wiring systems (to reveal) wiring (only/to examine) after a black box (to replace) several times. This not only (to place) functional systems into a depot line, but (to result) in extended aircraft down times. However, it (to accept) that replacing a black box (to be) much easier than troubleshooting an interconnection problem. Typically wiring faults (can/take) 10 to 15 times longer to troubleshoot than box-related problems. This (to be) because technical order manuals (to provide) limited troubleshooting guidance for wiring. The lesson here (to be) that significant improvement in wiring integrity (only/can/

to achieve) by moving from a reactive to a proactive wiring system maintenance approach.

Many of the technologies (to require/ to make) a proactive approach a reality (to be) only concepts today and the infrastructure to make them successful (to have) yet to be fully developed. This (only/can/to accomplish) with a focused industry and government teaming to exchange ideas, develop new technologies, assess their effectiveness, and accelerate implementation of the most promising areas.

The large number of legacy systems (to make) a proactive maintenance approach particularly challenging. New maintenance approaches (to need/ to apply) into existing aircraft operations and maintenance without compromising the original design. A proposed strategy (to develop) research initiatives in five broad technology areas: failure characterization, new materials, advanced diagnostics, interconnection devices, and maintenance tools.

Exercise 17. Transfer the text into The Past Tense.

FAILURE CHARACTERIZATION

The causes and mechanisms of aging or degradation and the ultimate failure of wiring systems need to be fully characterized. The Air Force and other federal agencies are currently documenting failure mechanisms in wiring, connectors, and circuit breakers. Degradation mechanisms, time-dependent mechanisms, and defect sensitivities will need to be established in order to correlate failure mechanisms with field performance. The overall goal will be to develop models that can be used to design new wiring systems and predict failures in existing systems.

NEW MATERIALS

Many of the interconnection technologies currently in use are the result of incremental improvements over the past 30 years. There have been few revolutionary changes. New design approaches and materials are needed to achieve significant improvements in wiring integrity. This will require new interconnection designs and the application of new materials such as conductive polymers, fiber optics, and wireless systems. Additional research that explores innovative design approaches and materials is needed to realize revolutionary improvements in wiring system integrity.

ADVANCED DIAGNOSTICS

A current challenge is to develop nondestructive evaluation (NDE) or diagnostic techniques for inspection and detection of defects before they affect electrical system operation. Most systems currently available measure impedance changes to locate shorts or opens in connectors and cables. Electrical shorts and opens, and their relative distance from a test signal can be reliably determined for controlled impedance systems, such as coax or twisted pair wiring. Extending this capability to unshielded primary single conductor wiring offers significant challenges. The Air Force is currently evaluating several technologies that show promise is this area. These systems will initially be used to aid in locating and repairing wiring failures. Once proven and optimized, they can be used to check the integrity of selected wiring sub-systems. This would begin a transition from a “fix-

it-when-it-breaks" maintenance approach to a proactive one that allows wiring maintenance to be scheduled prior to a system failure. If successful, this proactive methodology could replace current general visual inspection methods.

Several programs are attempting to develop embedded or remotely controlled sensors that can monitor the integrity of wiring systems. This advanced approach could lead to wiring systems that automatically reconfigure to maintain critical circuit paths or conduct a diagnostic check on their integrity without having to disconnect connectors.

INTERCONNECTION DEVICES

Research in this area is addressing interconnection technologies such as circuit breakers, connectors, modular wire systems, and fiber optical systems. The development of arcfault circuit breakers is an excellent example of a government and industry team effort. This technology, originally designed for the building industry and now being applied to aircraft, has the potential to protect wiring from arcs of short-duration, which typically are not detected by conventional circuit breaker devices. Efforts, thus far, include developing plating systems and materials for connectors that are resistant to corrosion, maintaining electrical bonding resistance over extended periods, and minimizing the use of heavy metals and other materials considered hazardous.

Additional research is needed to improve the reliability of electro-mechanical devices, such as circuit breakers, relays, and switches. One approach uses microelectromechanical systems (MEMs) to improve reliability and reduce component costs. An area that merits further development is the use of wireless communication technology for critical control paths. This will require research into technologies that ensure secure and reliable communication channels.

MAINTENANCE TOOLS

A variety of tools and technologies are required to manage aging wiring systems effectively. One technology need not be listed—repair technology; since many of the current repair techniques were originally developed as temporary fixes but in several instances have become permanent installations. New materials and processes are needed to make permanent repairs rapidly.

Finally, from a management perspective, the areas below need to be addressed to cost effectively manage the overall health and integrity of the wiring system:

Vehicle Modeling—the wiring system architecture and system requirements need to be fully documented. Limits need to be identified for proper system operation, including configuration management.

Test Planning/Monitoring—planning, tracking and managing systems are needed for validating and testing each wiring system component over the course of a vehicle's lifetime.

Testing—test equipment is needed that is capable of detecting anomalies in the wiring system, including the degradation (by contamination, physical abuse, or aging) of conductors, insulation and electromechanical components.

Data Management—collection, display and archiving of wiring system data, generated via a comprehensive wire integrity program, is needed.

Exercise18. Answer the following questions:

1. What does Vehicle Modeling mean?
2. What does MEM stand for?
3. Why do degradation mechanisms, time-dependent mechanisms, and defect sensitivities need to be established?
4. What has the potential to protect wiring from arcs of short-duration, which typically are not detected by conventional circuit breaker devices?
5. What will require new interconnection designs and the application of new materials such as conductive polymers, fiber optics, and wireless systems?

Exercise 19. Give the structural analysis of the sentences.

A significant improvement in wiring system integrity will require a focused investment in technology through collaboration among industry, academia, and government.

The “Review of Federal Programs for Wire System Safety” report of 2000 provides a roadmap to achieve this significant objective.

The recommendations of the report are worth reviewing, since they provide a good starting point for developing wiring systems that operate for extended failure-free operating periods.

Significant improvements in wiring system integrity will be dependent on implementing four basic strategies.

These include: altering the perception of wiring systems; increasing collaboration between industry, academia and the government; improving the management and functionality of wire systems; and developing advanced wiring system technologies.

Exercise 20. Translate the text into English.

ИЗМЕНЕНИЕ ПАРАДИГМЫ ЭЛЕКТРОМОНТАЖА

К электропроводке часто относятся как к предмету, который "установил и забыл", а не как к незаменимой системе. Для обеспечения долгосрочной целостности систем электропроводки необходимо значительное изменение культуры проектирования, монтажа и обслуживания. Необходимо сделать акцент на предотвращении повреждений с помощью прогностики и диагностики. Поврежденные компоненты системы электропроводки должны быть обнаружены неинтрузивным способом, прежде чем система перестанет функционировать должным образом или не будет функционировать вообще. Обнаружение таких повреждений потребует изменения философии с преимущественно реактивного на более проактивный подход к техническому обслуживанию.

Exercise 21. Render the text.

INCREASING COLLABORATION

A partnership between industry, academia, technical associations, and the government is essential to develop synergy and to take advantage of the abundant experience and expertise in the wiring system community. The improvement of data collection and sharing is of primary importance. Air Force (AFRL/ML) research is driven by the needs of the warfighter community. This group relies heavily on field data and industry recommendations for improvement.

Currently, no common database exists among industry, academia, and the government for wiring failure histories. In addition, no common method exists for disseminating data on wiring system failures. Wiring system failures are often attributed to systems or identified as minor repairs.

To a considerable extent, good data leads to good policy. Data will provide the feedback needed to implement the four basic strategies. The cultural shift in attitude toward building and maintaining systems with extended failure-free operating periods will be largely driven by data. These data are also needed to help evaluate current practices and to set priorities for research initiatives based on cost, time, and overall risk. There will also be a need to more effectively focus resources on the identified wiring issues and move towards the goal of increasing wiring system integrity.

Exercise 22. Put 5 types of questions to each sentence.

IMPROVING MANAGEMENT AND FUNCTIONALITY

Standardized design tools are needed to develop and track design parameters and changes in the configuration of wiring systems.

These tools should alert those who design, maintain, and operate wiring systems to conditions that may cause failures or jeopardize system redundancy.

New prognostic and diagnostic technologies and maintenance tools are needed for managing aging systems and new systems that are even more complex and dependent on electrical functions.

Repair processes are needed that are rapid, permanent and reliable.

Failure characterization data and non-intrusive diagnostic tools need to be integrated into a comprehensive wiring management system.

Research is also needed to develop models for ascertaining when systems should be replaced or retrofitted.

In addition, more intensive and detailed training is required in the installation, inspection, and maintenance of wire systems.

Exercise 23. Put the words in the correct order.

DEVELOPING ADVANCED WIRING SYSTEM TECHNOLOGIES

1. multiplexing, technologies, conductors, Wireless, fiber-optic, reducing, micro-electronic, and, in, on, copper, offer, promise, multiple, reliance, great

2. The, to, in, to, and, and, is, new, best, wire, these, other, through, develop, achieve, systems, materials, research, aggressive, opportunity, technologies initiatives, improvements, revolutionary.

Exercise 24. Comment on the following:

In the past, wiring has been treated as a commodity.

Recent events have highlighted the need to treat wiring as a whole system.

There are several new technologies from multiple industry sectors that have the potential to significantly improve overall wiring system integrity and lead to wiring systems that have extended failure free operating periods.

ASSIGNMENT TO ALL THE TEXTS GIVEN IN THE UNIT.

1. What are the points raised in the texts?
2. What is your person opinion on the problem?
3. What are the key ideas of the texts?
4. What points would you stress if you had to give your point of view?
5. What conclusions can you make?
6. Do you share the authors' point of view?
7. Comment on the main problems of the texts.

Unit 2. Wiring Installation – Wiring Diagrams.

Exercise 1. Express your ideas on the following:

As confidence in the technology grows, some of the wires that carry data in fly-by-wire jets might be replaced.

Some of the world's top avionics and airframe experts have taken up the challenge under a project called WAIC, short for wireless avionics intra-communications.

Exercise 2. Read the sentences given below and write them:

trænˈsiːvə ˈmɒdjuːlz ˈweɪɪŋ lɛs ðæn ˈθɜːˈtiːn græmz wʊd biː ɪnˈstɔːld ɒn kəmˈpəʊnənts θru(ː)ˈaʊt ðə pleɪn.

ˈpaʊə kʊd biː səˈplaɪd baɪ ə lɒŋ-laɪf ˈlɪθɪəm ˈbætəri ɔː baɪ ˈhɑːvɪstɪŋ ˈæmbɪənt ˈɛnədʒi ænd ˈstɔːrɪŋ ɪt ɪn ˈs(j)uːpə kəˈpæsɪtəz.

Exercise 3. Read and translate the text.

A look at the payoffs and challenges of removing wires from airlines

If you removed all the wires from a widebody passenger jet and strung them end-to-end, you could connect St. Louis to Chicago or London to Amsterdam,

distances of approximately 500 kilometers. If you rolled these 100,000 wires into a ball with the harnesses that hold them to the aircraft structure and put the ball on a scale, it would tip to nearly 7,400 kilograms or about 3 percent of the aircraft's weight.

Many of these wires supply electricity to components, but many others transmit operational data, including avionics, flight-control commands and sensor data on the performance of components like pneumatic and hydraulic systems. Research engineers think that in five years they will have cleared enough technical and regulatory hurdles to begin replacing many data-carrying wires with wireless transceivers.

First to go would be wiring for non-avionics functions, such as control of cabin lighting and passenger audio-video equipment or devices gathering routine health-management data from around the plane. Next might be safety-related wiring linked to smoke detectors, emergency lighting, cabin-pressure sensing and avionics, and eventually even commands that move the plane's flight-control surfaces.

All told, it might be possible for a modern widebody to shed up to 1,800 kilograms of wiring, according to Mauro Atalla, vice president for engineering and technology at United Technologies Corp.'s Sensors and Integrated Systems division in Minnesota, one of the companies researching internal wireless communications for airliners.

Removing that much wiring is an ambitious goal, driven in part by a pressing desire among airlines to accommodate more and more health-monitoring equipment to identify failing parts before they pose a safety risk or disrupt airline schedules. The shift toward wireless communications also would enhance safety and make it easier to upgrade components, advocates say.

Some of the world's top avionics and airframe experts have taken up the challenge under a project called WAIC, short for wireless avionics intra-communications, coordinated by Texas A & M University's Aerospace Vehicle Systems Institute. The work is self-funded by participating organizations and includes a growing list of avionics companies and aircraft manufacturers.

U.S. component suppliers Honeywell and United Technologies have been involved, as have Airbus, Boeing, Bombardier of Canada, GE Aviation, Embraer of Brazil and Gulfstream. Most recent to join are NASA, Lufthansa Technik of Germany, Thales of France and Zodiac Inflight Innovation of California and Germany. They will contribute their expertise to laboratory and flight tests.

How might a wireless system work? United Technologies, better known as UTC, agreed to describe its approach for us. Transceiver modules weighing less than 13 grams would be installed on components throughout the plane. Each would send data from the component or receive commands from the flight crew or automated systems.

To power these modules, UTC is considering different methods. Power could be supplied by a long-life lithium battery or by harvesting ambient energy and storing it in super capacitors. Any batteries would be non-recharging to avoid risks of overheating and fire.

These transceiver modules, or nodes, would be connected to remote data concentrators, weighing less than 200 grams, located strategically around the plane. These concentrators, similar to routers in homes and buildings, would be powered by the aircraft's electrical system. They would collect data from (or send it to) transceiver modules and route it where it needs to go. That could mean to the aircraft interface device for transmission to the ground by radio, broadband or cell network. If the crew needed to see the data, it would be transmitted to a cockpit tablet interface module that would be connected wirelessly or by wires to tablet PCs for display to the pilots.

Exercise 4. Give the Russian equivalents for the following words and word combinations and learn them.

widebody passenger jet, operational data, sensor data on the performance of components, technical and regulatory, wireless transceivers, non-avionics functions, routine health-management data, safety-related wiring, cabin-pressure sensing and avionics, emergency lighting, smoke detectors, to identify failing parts, to disrupt airline schedules, wireless avionics intra-communications, a long-life lithium battery, by harvesting ambient energy, non-recharging, risks of overheating and fire, concentrators, to route, a cockpit tablet interface module, broadband or cell network.

Exercise 5. Answer the following questions:

1. What are the points raised in the article?
2. Comment on the main problems of the article.
3. What does the article begin with?
4. To what problem does the author go on?
5. What does the author conclude (summarize)?

Exercise 6. Give the short summary to the text in exercise 3.

Exercise 7. Put 5 types of questions to each sentence.

1. Many of these wires supply electricity to components, but many others transmit operational data, including avionics, flight-control commands and sensor data on the performance of components like pneumatic and hydraulic systems.
2. The shift toward wireless communications also would enhance safety and make it easier to upgrade components, advocates say.
3. Some of the world's top avionics and airframe experts have taken up the challenge under a project called WAIC, short for wireless avionics intra-communications, coordinated by Texas A & M University's Aerospace Vehicle Systems Institute.
4. To power these modules, UTC is considering different methods.
5. Research engineers think that in five years they will have cleared enough technical and regulatory hurdles to begin replacing many data-carrying wires with wireless transceivers.

Exercise 8. Fill in the gaps, using the necessary preposition:

The Aerospace Vehicle Systems Institute says wireless technology potentially could be used _____ an aircraft, including these safety applications: Smoke detection, Door sensors, Fuel tank and line monitor, Temperature, Engine sensors, Humidity and corrosion detection, Cabin pressure, Emergency lighting, Ice detection, Flight controls position feedback, Air data, Flight deck and cabin crew imagery/video, Landing gear, Avionics communications bus, Structural health monitoring, Active vibration control.

The WAIC research is aimed ___ the boldest part ___ the wireless shift, which would be transmission ___ data related ___ safety and regularity__ flights. Passenger entertainment and communications are going wireless too, but ___ different systems, although partly___ the same reasons: to reduce weight, cost and complexity.

The need ___ replacing wiring is increasing, especially___ widebody aircraft. ___ 1984, a Boeing 767-200ER had 140 kilometers ___ wiring. Today, a modern twin-aisle aircraft ___ the Boeing 787 has ____ 500 kilometers ___ wiring. Wiring weight ___ a single-aisle jet is about half the twin-aisle total, but the proportional burden is the same.

Exercise 9. Read and translate the text. Mind the articles and fill in the gaps: A/AN THE or "ZERO ARTICLE"

David Redman heads ____ Aerospace Vehicle Systems Institute's efforts to coordinate_____ research on WAIC. He recalls it took from 2008 to 2015 to take ___ first regulatory step: securing ___ dedicated WAIC frequency of 4,200 to 4,400 megahertz from ____ World Radiocommunication Conference, which meets every three to four years to make ____ decisions about ___ radio spectrum.

Redman is coordinating ___ research to help ___ RTCA, ___ association founded in 1935 as ____ Radio Technical Commission for Aeronautics, to establish ____ performance standards for WAIC equipment. ___ key aim is to ensure that ___ WAIC applications won't interfere with those on ___ other aircraft, with each other or with ___ radio altimeters, which derive ____ altitude by measuring ____ time it takes ____ radio wave to reflect from ____ ground and return to ____ plane. All of these devices operate in ____ same 4,200 to 4,400 megahertz band.

Atalla of UTC expects ____ minimum operational performance standard for WAIC to be developed by mid-2019. ____ Redman expects certified ____ WAIC applications in about five years.

Exercise 10. Open the brackets, put the verbs in the correct tense form, voice and translate the text.

Wireless nodes (must/to be) light, small, low power and cheap if they (to be going/to be) attractive and realistic replacements for wires. How to power the nodes (remain) a major question. Lithium batteries and harvesting ambient energy (to be)

among the options, but there (to be) a third idea. Passive radio-frequency identification tags (might/ to remain) dormant until powered briefly by signals from the RFID readers that (to interrogate) them.

For both nodes and power, Redman (to hope) that WAIC (can/ to piggyback) on advances in consumer or other industrial markets that (to have) much higher volumes on which (to recover) investments.

As confidence in the technology (to grow), some of the wires that (to carry) data in fly-by-wire jets (might/to replace). That (would/ to be) a big breakthrough, because safety-related connections now (to require) two or three redundant wires (to ensure) functions if one of the wires (to chafe) or (to fail) for some other reason. If a wireless link (to install) in place of one wire, the result (to be) what Redman (to call) a dissimilar redundancy, which (to be) often a preferable strategy. The same safety data (would/ to carry) by both wire and wireless connections, rather than relying solely on wires that (can/ all/ to fail) for the same reason.

And Redman (to note) that the weight reduction for WAIC (might/ to be) proportionally greater than if engineers (can/ to reduce) the wiring required to supply electricity to components. Wires that (to carry) data, including fiber-optic cables, (to be) typically heavier and more expensive and complex than those that (to carry) electric power.

Redman (to observe) that eliminating wires also (to free up) space, always at a premium on aircraft. Wires (to take up) space themselves and (to need) additional room for their separation.

Upgrading equipment on today's jets (can/ to be) a major undertaking, but with the new approach mechanics (would/ just/ have to/ to replace) the component and attached module, rather than disentangle, remove and safely replace bundles of wires. Especially for new aircraft, installing wireless devices (can/ to be) much easier than installing all those connecting wires.

On top of these benefits, advocates (to suspect) there (to be) payoffs that (to anticipate) yet. In today's designs, sensors (to need) wires, and that (to limit) where they (can/ to place). Functions that (to be) not practical or economic today with wired systems (might/ suddenly/ to make) sense.

Exercise 11. Translate words and word-combinations. Mind the sentences with these words and word-combinations in written form.

Smoke detection, Door sensors, Fuel tank and line monitor, Temperature, Engine sensors, Humidity and corrosion detection, Cabin pressure, Emergency lighting, Ice detection, Flight controls position feedback, Air data, Flight deck and cabin crew imagery/video, Landing gear, Avionics communications bus, Structural health monitoring, Active vibration control.

Exercise 12. Render the text in English. Use the words and word -combinations given below.

wiring diagrams, aircraft service manuals, type of terminals, its serial number, the production run of an aircraft, troubleshooting electrical malfunctions, block

diagram, a printed circuit board, replaceable module, a pictorial diagram, conventional electrical symbols, the maintenance technician, a schematic diagram, with respect to each other, are best utilized for.

Электрические схемы включаются в большинство руководств по обслуживанию самолетов и содержат информацию, такую как размер провода и тип клемм, которые должны использоваться для конкретного применения. Кроме того, на электрических схемах обычно указывается каждый компонент системы по номеру детали и серийному номеру, включая все изменения, которые были внесены в процессе производства самолета. Электрические схемы часто используются для поиска и устранения неисправностей в электрооборудовании.

Блок-схемы

Блок-схема используется в качестве вспомогательного средства для поиска неисправностей в сложных электрических и электронных системах. Блок-схема состоит из отдельных блоков, представляющих несколько компонентов, таких как печатная плата или другой тип сменного модуля.

Пиктографические диаграммы

В пиктографической схеме вместо обычных электрических символов, встречающихся в традиционных схемах, используются изображения компонентов. Пиктографическая диаграмма помогает техническому специалисту визуализировать работу системы.

Схематические диаграммы

Схематические диаграммы используются для иллюстрации принципа работы и поэтому не показывает детали в том виде, в котором они на самом деле представлены или как они функционируют. Однако на схемах указывается расположение компонентов относительно друг друга. Схематические диаграммы лучше всего использовать для поиска и устранения неисправностей.

Unit 3. Development of Wireless Avionics Intra-Communication

Exercise 1. Express your ideas on the following:

With clear advantages to installing WAIC on aircraft, industry groups are progressing on making the technology a reality.

Exercise 2. Read the transcription.

ɪˈnɪʃəli, ˈdʌblju(ː)-eɪ-aɪ-siː rɪˈkwaɪəd ˌklæsɪfɪˈkeɪʃən tuː biː ˈfɒləʊd baɪ ðə ˈpɜːpəsfʊl dɪˈrɛkʃən ɒv ə kəˈmɪti ˈteɪlərɪŋ ɪt, spəˈsɪfik(ə)li, ˈɪntuː ən ˌeɪvɪˈɒnɪks ˈstændəd.

ˈɔːlsəʊ, bɪˈkɒz ˈdʌblju(ː)-eɪ-aɪ-siː ˈfriːkwənsiz ɑːr əˈrɪʤɪneɪtɪŋ frɒm ˈeəkrɑːft ðæt ɑː ˈtrænzɪənt, baɪ ˈkrɒsɪŋ ˌɪntə(ː)ˈnæʃənl ˈbaʊndəriz, ɪt rɪˈkwaɪəd ðə kəˌlæbəˈreɪʃən ɒv

bəʊθ aɪ-tiː-juː ænd ðiˌɪntə(ː)ˈnæʃənl ˈsɪvlˌeɪvɪˈeɪʃ(ə)nˌɔːgənaɪˈzeɪʃən ɪn ənˈəʊvərɔːlˌklæsɪfɪˈkeɪʃən ˈɛfət.

ði aɪ-tiː-juː ɪnˈʃʊəz ˈhɑːmənaɪzd ˈæksɛs tuː ɪˌlɛktrəʊmægˈnɛtɪk ˈfriːkwənsiz, ˌwɜːldˈwaɪd.

Exercise 3. Read and translate the text.

While avionics engineers, producers and installers busy themselves with ADS-B mandate activity, it might be an extra burden for them to focus on new developments in the industry. One is the recent migration of wireless avionics intra-communication (WAIC) technology into aircraft platforms.

WAIC is a potential means of reducing aircraft wiring by 30%, using wireless devices to communicate data, on radio frequencies and in place of wiring, between aircraft systems that function for safety and regularity of flight. (Such devices do not include those used for air-to-ground, air-to-satellite, air-to-air or in-flight entertainment purposes.)

Initially, WAIC required classification to be followed by the purposeful direction of a committee tailoring it, specifically, into an avionics standard. Because WAIC involves the use of radio frequencies that may be used by others, classification of WAIC had to commence with activity under the International Telecommunications Union – Radiocommunications Sector (ITU-R). Also, because WAIC frequencies are originating from aircraft that are transient, by crossing international boundaries, it required the collaboration of both ITU and the International Civil Aviation Org. (ICAO) in an overall classification effort.

The ITU ensures harmonized access to electromagnetic frequencies, worldwide. The ICAO, similarly, ensures harmonized standards and operations for aviation. The classification of WAIC originally focused on low and high data rates as well as location-related aspects, either inside or outside the aircraft. For the WAIC operating frequency spectrum, ITU initially commenced with the assumed range of 2 to 5 GHz. The 2011 report from the ITU-R was issued as an M document, covering the “mobile, radio-determination, amateur and related satellite services,” and issued as M.2197.

Since 2008, another group has played a major role in the overall development, classification and standardization of WAIC. The Aerospace Vehicle Systems Institute (AVSI), a cooperative of companies, academia and government agencies, centered on the Texas A&M University campus, has nurtured and promoted the WAIC concept with heavyweight aviation

giants deeply engaged. Current members, beyond the university's Engineering Experiment Station, include Boeing, Airbus, Embraer, Harco, Honeywell and United Technologies. BAE, Gulfstream and Bombardier also have played a significant role earlier in the institute's WAIC work.

After the release of the ITU-R report, AVSI requested that the organization evaluate specific frequency bands within the 2- to 5-GHz range. Covered under Report M.2318.0, ITU evaluated the frequency bands 2,700 to 2,900 MHz, 4,200 to 4,400 MHz and 5,350 to 5,460 MHz.

The only frequency band below 15.7 GHz found to be suitable for WAIC and that would not cause or be subject to interference, was the 4.2 to 4.4 GHz band. But there was the issue of onboard radio (radar) altimeters also operating within the same frequency spectrum.

Knowing that the 4.2 to 4.4 GHz band was the right band for WAIC, AVSI and others worked toward a worldwide adoption that was finally announced at the 2015 World Radio Conference. This also meant that the FAA (RTCA), EASA (EUROCAE) and ICAO would all rally behind the assigned frequency and build on the ITU-R reports to develop standards. They would also seek to resolve the co-habitation of both WAIC and radio altimetry operating in the same band. Devices will be low (10 mW) or high (50 mW) power rated and expected to be positioned less than 330 ft (100 m) from each other.

Exercise 4. Give the Russian equivalents for the following words and word combinations and learn them.

an extra burden, wireless avionics intra-communication (WAIC) technology, a potential means of, to communicate data, radio frequencies, air-to-ground, air-to-satellite, air-to-air or in-flight entertainment purposes, to commence, the International Telecommunications Union – Radiocommunications Sector (ITU-R), to focus on, low and high data rates, operating frequency spectrum, assumed range, The Aerospace Vehicle Systems Institute (AVSI), the frequency bands, co-habitation.

Exercise 5. What do these abbreviations stand for?

ADS-B, WAIC, ITU-R, ICAO, AVSI, MHz, GHz, FAA (RTCA), EASA (EUROCAE), MOPS, APU, TSO, ETSO, NASA

Exercise 6. Answer the following questions:

1. What are the points raised in the article?
2. Comment on the main problems of the article.
3. What does the article begin with?
4. To what problem does the author go on?
5. What does the author conclude (summarize)?

Exercise 7. Prepare an abstract to the text given in Exercise 3.

Exercise 8. Analise the structure of the sentences and transfer the sentences into Active Voice.

1. Because WAIC involves the use of radio frequencies that may be used by others, classification of WAIC had to commence with activity under the International Telecommunications Union – Radiocommunications Sector (ITU-R).
2. The 2011 report from the ITU-R was issued as an M document, covering the "mobile, radio-determination, amateur and related satellite services," and issued as M.2197.
3. The argument for wire reduction is validated when a typical dual-aisle air carrier aircraft is reviewed.
4. Because of the WRC-15 frequency allocation, the equipment-licensing process may be applied globally, providing a harmonization of the technical and operational criteria.

Exercise 9. Analise the structure of the sentences and transfer the sentences into Passive Voice.

1. The ITU ensures harmonized access to electromagnetic frequencies, worldwide.
2. Since 2008, another group has played a major role in the overall development, classification and standardization of WAIC.
3. After the release of the ITU-R report, AVSI requested that the organization evaluate specific frequency bands within the 2- to 5-GHz range.
4. , WG-96 for Europe has been developing a process specification to define compliance methods for safety demonstration of systems using WAIC

Exercise 10. Fill in the gaps, using the necessary preposition:

Developing the Standard

AVSI was instrumental ___ the formation ____ a special committee and working group tasked ____ developing WAIC standards that will guide designers, engineers and installers ___ the production and integration ____ WAIC applications. Each consensus-based panel_____ experts is fully supported ____ the ICAO, ensuring spectrum usage falls_____ ICAO convention guidelines to obtain benefits_____ equipment certification. The two panels include RTCA SC-236 and EUROCAE WG-96.

The RTCA request is given ____ the form _____ formal tasking _____ the FAA, which leads _____ a terms _____ reference document. The document, issued ____ June 2016, calls_____ the

development _____ a Minimum Operational Performance Standard (MOPS) to allow WAIC devices to operate safely alongside radar altimeters. The RTCA defines MOPS_____ a system that "provides the information needed to understand the rationale_____ equipment characteristics and requirements stated, describe typical equipment applications and operational goals, and establish the basis_____ required performance _____ the standard." SC-236, working jointly _____ WG-96, is to develop the standard _____ operational safety communications systems onboard an aircraft to include engines, APU and landing gear.

Meanwhile, WG-96 _____ Europe has been developing a process specification to define compliance methods _____ safety demonstration ____ systems using WAIC. Though a joint effort, WG-96 will release a EUROCAE version ____ the same MOPS, both planned____ _ a 2019 completion.

Exercise 11. Put 5 types of questions to each sentence.

1. Meanwhile, WG-96 for Europe has been developing a process specification to define compliance methods for safety demonstration of systems using WAIC.
2. The RTCA request is given in the form of formal tasking from the FAA, which leads to a terms of reference document.
3. AVSI was instrumental in the formation of a special committee and working group tasked with developing WAIC standards that will guide designers, engineers and installers in the production and integration of WAIC applications.
4. The ICAO requires that any susceptibility of interference between different aircraft is evaluated, so there will be a WAIC standard and recommended practice developed to ensure coexistence between aircraft.
5. Due to the proximity of flights when using new performance-based navigation procedures, it is possible for aircraft to be flying within a closer distance from each other, creating a greater risk for WAIC interference.

Exercise 12. Read and translate the text. Mind the articles and fill in the gaps: A/AN THE or "ZERO ARTICLE"

There are ____ two primary MOPS requirements. One is that _____ safe operation of _____ radio altimeters is not compromised. ____Other is allowing _____ worst-case performance of ___ WAIC application to be pre-determined.

These are further divided into_____ following subset of _____ requirements: ____ coexistence of WAIC components and radio altimeters on ____ board _____ same aircraft; ____ coexistence of

WAIC components and radio altimeters on ____ board _____ different aircraft; ___ coexistence of WAIC components on ____ board ____ same aircraft; and ___ coexistence of WAIC components on ____ board one____ aircraft with WAIC components on ___board _____other aircraft.

Due to____ proximity of _____ flights when using new _____ performance-based navigation procedures, it is possible for ____ aircraft to be flying within ____ closer distance from ____ each____ other, creating____ greater risk for WAIC ____ interference. Specifically, with ____ respect to ____ radio altimeters, aircraft flying in____ close proximity, above or below ____ each ___ other as opposed to ____ side by ___ side, may be more prone to interference. This is because____ radio altimeter antenna is mounted on _____ aircraft's lower fuselage.

_____ ICAO requires that any _____ susceptibility of ____ interference between _____ different aircraft is evaluated, so there will be_____ WAIC standard and recommended practice developed to ensure _____ coexistence between _____ aircraft.

Additionally, _____ terms of _____ reference document addresses _____ possible _____ cybersecurity_____ concerns and links SC-236 activity to SC-216, _____ RTCA Aeronautical Systems Security Committee.

Exercise 13. Transfer the text into Past Tenses, read and translate it.

Why WAIC

Aviators are always looking for ways to reduce aircraft weight, to increase performance, for runway access and to use less fuel. Aside from contributing to these desires, WAIC technology improves aircraft safety and efficiency by removing electrical wiring between aircraft systems.

Notably, today's typical aviation department relies more on real-time downlinked performance and fault data from the aircraft. This increases the need for system sensors able to communicate the data to a central monitoring computer for transfer via satellite to the ground. Traditionally, this involves more wiring and therefore serves a greater need for high data capacity, safety-related wireless communication between aircraft systems.

Of significance is the ability of WAIC to inform on the status of aircraft moving parts and the monitoring of reliability impact elements, such as temperature, pressure, humidity and wear status. Future applications not able to be served by using wires alone, may be supplanted or supplemented by WAIC devices.

As risks are revealed, via function hazard and common mode failure analysis and lessened through the reduction of wiring, it is planned that double and triple system redundancy may also be mitigated in the future.

WAIC promotes the ability to reconfigure systems for upgrades or during integration for new product features. If these changes can be

accomplished by wireless reconfiguration, as opposed to wiring amendments, the advantage of having less touch points will be clear.

Because the WAIC standard will exist and be provided as guidance for the certification authorities and the industry alike, it should mean a less cumbersome process for the certification of equipment and especially for aircraft integration. Designers and certification engineers might apply a similar process as that applied to radio devices used in navigation, surveillance and communication systems.

Because of the WRC-15 frequency allocation, the equipment-licensing process may be applied globally, providing a harmonization of the technical and operational criteria.

This same harmonization applies to safety guidance material and design assurance guidance used to certify WAIC equipment.

Exercise 14. Render the text in English.

Аргумент в пользу сокращения количества проводов подтверждается при рассмотрении типичного двухпроходного воздушного судна. При приблизительном общем количестве проводов 100 000 и общей длине 292 мили (470 км) вес проводов, включенных в общий вес самолета, составляет 12 566 фунтов (5 700 кг) - типичный предел веса легкого самолета. Проводка должна быть закреплена по всему маршруту следования, поэтому добавьте еще около 4 189 фунтов (1 900 кг), или на 30% больше, и это не считая всех разъемов на концах. Предположим, что однопроходный самолет будет составлять около 50% от того и другого.

Конечно, устройства WAIC не устранят всю проводку, но, по оценкам, потенциально могут сократить общее количество на 30%, независимо от размера самолета.

На самом деле, устройства WAIC могут дополнить проводку самолета, чтобы добиться ее сокращения. Это связано с тем, что в системах, критически важных для безопасности, для каждой функции должно быть два отдельных провода, но, будучи проводами, оба могут иметь одинаковые модальные критерии отказа. Если один из них заменить с помощью беспроводной радиосвязи, то результаты анализа безопасности будут совсем другими.

Для определения требований к пропускной способности спектра датчики сначала группируются по высокой и низкой скорости передачи данных, а затем суммируются вместе для ожидаемого общего использования данных. По некоторым оценкам, общая потребность в данных WAIC составляет 145 МГц спектра для каждого двухпроходного самолета.

Exercise 15. Render the text.

As of September 2017, the SC-236 (WG-96) had received a thorough briefing of the WAIC requirement, the certification authority request and global context.

Also, the committee has been familiarized with MOPS, which will eventually lead to a DO-XXX document. Europe will further issue a draft ED 246 document for wireless onboard avionics network, which has already been open for comment.

The final MOPS may even be used as a basis for an FAA technical standard order (TSO) and a Europe ETSO, as applies to the design and approval of aircraft-related equipment. Equipment with TSO design approval will be eligible for use on FAA type-certificated aircraft.

Furthermore, the FAA could later issue an advisory circular and EASA a certification memo, both addressing the WAIC certification process.

As the work of SC-236 (WG-96) progresses, the scope and depth of required activity unfolds. By examining some of the public activity, it is possible to obtain a glimpse at the status and inner workings of WAIC standards development.

The MOPS breakdown will follow a standard format and, from a technical perspective, include the following major areas: equipment performance standard and environmental conditions; test procedures; manufacturer conditions; and operational performance characteristics.

In preparation for MOPS, the activity includes an understanding and development of industry guidance covering, at a minimum the following:

- The WAIC freqnecy spectrum requirements.
- High & Low/ Inside & Outside (the aircraft), date rates.
- The WAIC model.
- Radio altimeter protection via use of directional external WAIC device antennas.
- Security and encryption.
- Some of the important criteria for the physical equipment includes:
- Determination of both digital and analog bus sensor component.
- Power sources and requirements.
- Guidelines and contraints for the installation
- Antenna considerations, including location, orientation and field patterns.
- Maintenance of WAIC applications, including continued airworthiness.
- Retrofit and reconfiguration aspects.
- WAIC radio as wireless sensors.
- Radio frequency human protection.

- Applicability of other standards documents, particularly universally applied standards such as DO160G-Environmental, DO 254-Hardware & DO 178C-Software.
- One activity has been flight testing to check for the susceptibility of WAIC-like emission interference on radio altimeter frequencies, as recently conducted through a coordinated effort by NASA, Honeywell, Thales and Rockwell Collins.
- NASA also conducted a funded modeling research program, and in December 2016, it released a white paper covering reflective characteristics of WAIC emissions within aircraft cavities as well as a deployed/stowed nose landing gear.
- AVSI is a primary facilitator, arranging several tests and providing background or required data, to validate the developing standards.
- Aircraft outfitted with operational WAIC devices will fly further, longer, cheaper and greener than their fully wired counterparts. The industry can see the clear advantages of wireless safety communication. Aircraft builders and completion facilities have a whole new business sector to add to their portfolios, and if not incorporated at assembly, WAIC applications would be installed during major events or system upgrades.
- AVSI, RTCA SC-236 and EUROCAE WG-96 are diligently working with their industry partners on producing usable standards within the next three years, while the ICAO continues to ensure its global reach and harmonization.

AVS. Some of the important criteria for the physical equipment includes:

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three years, while the ICAO continues to ensure its global reach and harmonization.

Exercise 16. Give the Russian equivalents for the following words and word combinations and learn them.

consensus-based panel, spectrum usage, within ICAO convention guidelines, to obtain benefits, reference document, Minimum Operational Performance Standard, to operate alongside radar altimeters, typical equipment applications and operational goals, to define compliance methods, primary MOPS requirements, the worst-case performance, coexistence, Due to the proximity of flights, new performance-based navigation procedures, within a closer distance, with respect to radio altimeters, prone, susceptibility, additionally, cybersecurity, the RTCA Aeronautical Systems Security Committee, runway access, aside from contributing to these desires, notably, real-time downlinked performance and fault data, via satellite to the ground, may be supplanted or supplemented by, lessen, function hazard, double and triple system redundancy, mitigate, can be accomplished by wireless reconfiguration, wiring amendments, surveillance system, a typical dual-aisle air carrier aircraft, irrespective of, safety-analysis outcome, for spectrum bandwidth requirements, wireless onboard avionics network, be eligible for, the scope and depth of required activity unfolds, encryption, susceptibility, aircraft cavities, primary facilitator.

Exercise 17. Put 5 types of questions to each sentence.

1. The MOPS breakdown will follow a standard format and, from a technical perspective, include the following major areas: equipment performance standard and environmental conditions; test procedures; manufacturer conditions; and operational performance characteristics.
2. The FAA could later issue an advisory circular and EASA a certification memo, both addressing the WAIC certification process.
3. Notably, today's typical aviation department relies more on real-time downlinked performance and fault data from the aircraft.
4. . Future applications not able to be served by using wires alone, may be supplanted or supplemented by WAIC devices.
5. The argument for wire reduction is validated when a typical dual-aisle air carrier aircraft is reviewed.

ASSIGNMENT TO ALL THE TEXTS GIVEN IN THE UNIT.

1. What are the points raised in the texts?
2. What is your person opinion on the problem?
3. What are the key ideas of the texts?

4. What points would you stress if you had to give your point of view?
5. What conclusions can you make?
6. Do you share the authors' point of view?
7. Comment on the main problems of the texts.

Unit 4. Application of Artificial Neural Networks in Aircraft Maintenance, Repair and Overhaul Solutions

Exercise 1. Express your ideas on the following:
Aircraft Maintenance, Repair and Overhaul (MRO). MRO solutions are designed to facilitate the authoring and delivery of maintenance and repair information to the line maintenance technicians who need to improve aircraft repair turn around time, optimize the efficiency and consistency of fleet maintenance and ensure regulatory compliance.

Exercise 2. Read and translate the text. Give the structural analysis of the sentences. Give the short summary.

NEURAL NETWORKS

An Artificial Neural Network (ANN) is a mathematical model or computational model based on biological neural networks. It consists of an interconnected group of artificial neurons and processes information using a connectionist approach to computation. In more practical terms neural networks are non- linear statistical data modeling tools. They can be used to model complex relationships between inputs and outputs or to find patterns in data. Since neural networks are best at identifying patterns or trends in data, they are well suited for prediction or forecasting.

SELF ORGANISING MAPS (SOM)

The self-organizing map (SOM) is an excellent tool in exploratory phase of data mining. It projects input space on prototypes of a low-dimensional regular grid that can be effectively utilized to visualize and explore properties of the data. When the number of SOM units is large, to facilitate quantitative analysis of the map and the data, similar units need to be grouped, i.e., clustered. Self- organizing map (SOM) is a type of artificial neural network that is trained using unsupervised learning to produce a low-dimensional (typically two dimensional), discrete representation of the input space of the training samples, called a map. The map seeks to preserve the topological properties of the input space.

This makes SOM useful for visualizing low-dimensional views of high-dimensional data, akin to multidimensional scaling.

MULTI-DIMENSIONAL SCALING

It is a set of related statistical techniques often used in information visualization for exploring similarities or dissimilarities in data. MDS is a special case of ordination. An MDS algorithm starts with a matrix of similar items, then assigns a location of each item in a low-dimensional space, suitable for graphing or 3D visualization.

FUZZY LOGIC

Fuzzy logic is a form of multi-valued logic derived from fuzzy set theory to deal with reasoning that is approximate rather than precise. Just as in fuzzy set theory the set membership values can range (inclusively) between 0 to 1, in fuzzy logic the degree of truth of a statement can range between 0 to 1 and is not constrained to the two truth values i.e. true or false as in classic predicate logic. And when *linguistic variables* are used, these degrees may be managed by specific functions.

Fuzzy logic is a new way of expressing probability. While both fuzzy logic and probability theory can be used to represent subjective belief, fuzzy set theory uses the concept of fuzzy set membership. The fuzzy probability can also be generalized as a possible model.

APPLICATION OF NEURAL NETWORKS WORK IN MRO

Neural network has a great role in aircraft fault diagnosis. It uses historical data stored to analyze the condition and trace the fault. However, neural networks cannot be the deciding factor as it is based on probability. Hence it helps man to decide the problem and work upon it by giving the probability of damage.

The system works according to the following procedure:

The information regarding the aircraft is fed into the neural system.

The system analyzes the data and checks for historical models corresponding to the data.

Then based on the records, the system throws out probabilities.

An experimental model is compared to the result of the ANN model.

This neural system gives man a better idea of the current problem or condition and hence increases efficiency of the whole MRO system.

This prediction of fault diagnosis is based on the Self-Organizing Map (SOM). SOM is a type of artificial neural network that is trained to produce a discrete representation of the input space of the training samples, called a map. Any input may affect many parts of an aircraft. SOM separates the input for the different parts hence giving an output for each part.

SOM uses Multi-Dimensional Scaling (MDS) in order to create its map. MDS is a set of related statistical technique often used in information visualization for exploring similarities or dissimilarities in data. MDS is a special case of ordination i.e. data clustering. It clusters similar data near each other and dissimilar data far from each other.

For high performance aircraft systems, there is a need to achieve real-time and continual assessment of aircraft condition. It is almost impossible to predict a damage of component correctly since operating conditions might be different. Hence these conditions must be accounted for.

An aircraft is affected mainly by the following factors:

Flying Hours, Aircraft Repair History, Airport Location, Climate, Weather.

Depending on these factors (called variables in the ANN program) and compared with the OEMs, predictions are made as to the wear and tear of the parts, the next date for servicing, and replacement of any part if needed.

Any increase in temperature or altitude means a decrease in the aircraft's optimum performance. At high elevation airports, an airplane requires more runway to take off. Its rate of climb will be less, its approach will be faster, because the true air speed will be faster than the indicated air speed and the landing roll will be longer.

Air density also decreases with temperature. Warm air is less dense than cold. As a result, on a hot day, an airplane will require more runway to take off, will have a poor rate of climb and a faster approach and will experience a longer landing roll.

The combination of high temperature and high elevation produces a situation that aerodynamically reduces drastically the performance of the airplane. The horsepower output of the engines decrease because its fuel-air mixture is reduced. The propeller develops less thrust because the blades, as airfoils, are less efficient in the thin air. The wings develop less lift because the thin air exerts less force on the airfoils. As a result, the take-off distance is substantially increased climb performance is substantially reduced and may, in extreme situations, be non-existent.

Depending on the number of hours an aircraft has flown in the past, and the number of repairs the aircraft has had in the past, the efficiency of the airplane changes. This calls for different treatment to planes in different conditions.

The neural network system analyzes these data of an aircraft and can hence suggest possible treatments suited to that aircraft. Hence diversity can be maintained and performance can be enhanced.

PROPOSED MRO SYSTEM

The proposed system applies the concept of Artificial Neural Networks (ANN). In this system when there is any problem at any part in an aircraft then that component is reviewed. After that the OEM manuals are referred and its possible problem area and its repair are estimated and its output is fed into the ANN as an input.

In the other half we apply the concept of Artificial Neural Network (ANN) to the system. The various factors on which the performance of an aircraft depends such as repair history, weather, climate, airports location, flying hours etc. are taken as inputs. We also need a collection of the historical data of all these variables and which will also be updated in real time as per its assessment of the result after each evaluation. These variables supported by the historical data and the input from the OEM manual are then given to the ANN. The ANN works on the basis that the high dimensional data input is converted to low dimensional with the help of Self Organizing Map (SOM) technique. The data is then clustered with the help of Multi-Dimensional Scaling (MDS), in different categories in relevance to the other data inputs. After that relevant logic is applied in the system to create probability prediction model of the possible percentage probability of damage in all the possible nodes of an aircraft. Many irrelevant data is eradicated by this system based on the historical data and thus the working of the system is also faster.

Now this Neural Network assesses both the input from the OEM manual and the data given by the variables and then formulates the output. The output gives the possible problem nodes in an aircraft and its repair options which is more accurate

than the output given by the OEM manual. The output of the Artificial Neural Network is then fed back into the historical data as repair history which prepares the system for further reference thus building a database. This output will then be given to the technicians who will act accordingly and rectify the problem.

Advantages over the existing system:
Less involvement of human interface.
Real time updation of records.
More accurate predictions of damage.
Helps in cost minimization of maintenance.
Better decision making and support systems.

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