

UNIVERZITET U BEOGRADU
SAOBRAĆAJNI FAKULTET

Dr Fedja NETJASOV

**METODI OCENE BEZBEDNOSTI VAZDUŠNE
PLOVIDBE**

**METHODS FOR RISK AND SAFETY ASSESSMENT OF AIR
NAVIGATION**

– III izdanje –

BEOGRAD
2021.

Dr Feda Netjasov

METODI OCENE BEZBEDNOSTI VAZDUŠNE PLOVIDBE / METHODS FOR RISK AND SAFETY ASSESSMENT OF AIR NAVIGATION

III izdanje

Za izdavača: dekan, dr Nebojša Bojović

Glavni i odgovorni urednik: dr Marijana Petrović

Tehnički urednik: Gordana Marjanović

Korice: Predrag S. Zdravković

Izdavač: Univerzitet u Beogradu – Saobraćajni fakultet, Vojvode Stepe 305, telefon: 3976–017; fax: 3096–704;
<http://www.sf.bg.ac.rs>

Multimedijalna obrada diska i štampa: Pekograf d.o.o., 11080 Zemun, Vojni put 258/d, telefon/fax: 3149–166; e-mail: pekograf@sbb.rs; <http://www.pekograf.com>

Tiraž: 50 primeraka

ISBN 978–86–7395–309–0

DOI <http://doi.org/10.37528/FTTE/9786673953090.VZ>

Na osnovu odluke Uređivačkog odbora Saobraćajnog fakulteta Univerziteta u Beogradu broj 946/2 od 12. oktobra 2021. godine, odobrava se za upotrebu u nastavi kao autorizovana skripta za predmet "Metodi ocene bezbednosti vazdušne plovidbe" na master studijama

СИР – КАТАЛОГИЗАЦИЈА У ПУБЛИКАЦИЈИ

Народна библиотека Србије, Београд

656.7.08(0.034.2)

NETJASOV, Feda, 1974-

Metodi ocene bezbednosti vazdušne plovidbe [Elektronski izvor] = Methods for risk and safety assessment of air navigation / Feđa Netjasov. - 3. izd.
- Beograd : Univerzitet, Saobraćajni fakultet, 2021 (Zemun : Pekograf). - 1 elektronski optički disk (CD-ROM) ; 12 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 50. - Biografija autora. - Bibliografija.

ISBN 978-86-7395-309-0

a) Ваздушни саобраћај -- Безбедност

COBISS.SR-ID 48200713

PREDGOVOR

"Metodi ocene bezbednosti vazdušne plovidbe" su autorizovana skripta sastavljena na osnovu nastavnog plana i programa predmeta "Metodi ocene bezbednosti vazdušne plovidbe" koji se predaje na master akademskim studijama na Saobraćajnom fakultetu Univerziteta u Beogradu na modulima za Vazdušni saobraćaj i transport i Operaciona istraživanja u saobraćaju.

Skripta su prvenstveno namenjena studentima master akademskih studija na Modulima za Vazdušni saobraćaj i transport i Operaciona istraživanja u saobraćaju kao i doktorskim akademskim studijama na Saobraćajnom fakultetu Univerziteta u Beogradu. Takođe, skripta mogu biti od koristi svim profesionalcima u sistemu vazdušnog saobraćaja u cilju proširenja i ažuriranja znanja iz oblasti bezbednosti vazdušne plovidbe.

Materija koja je izložena u ovim skriptama odnosi se uglavnom na civilno vazduhoplovstvo i zasniva se velikim delom na međunarodno priznatim metodama ocene rizika i bezbednosti vazdušne plovidbe.

Oktobar, 2021.

Autor

CONTENTS

1. METHODS, MODELLING AND MODELS

- System
- Modelling and Models
- Purpose of the models
- Model types
- Method and Modelling methods
 - Analytical methods
 - Numerical methods
 - Simulation methods
- Modelling principles
- Classification of models
 - Physical vs. abstract models
 - Static vs. dynamic models
 - Continuous vs. discrete models
 - Stochastic vs. deterministic models
 - Autonomous vs. non-autonomous models
 - Time invariant vs. variant models
- Mathematical Modelling process
 - Real World Problem
 - Working Model
 - Mathematical Model

- Computational Model
- Results/Conclusions
- Mathematical Modelling Process – Example
- Risk and safety modelling in civil aviation
 - Causal methods/models
 - Collision risk methods/models
 - Human factor error methods/models
 - Third-party risk methods/models

2. HAZARDS IDENTIFICATION

- Hazard
- Risk Management
- Generic Safety Assessment Process
- Functional Hazard Assessment
- Brainstorming approach
- Other Hazard Identification Approaches
 - Hazard and Operability Study (HAZOP)
 - Checklist
 - Failure Modes and Effects Analysis (FMEA)
 - Structured What-if (SWIFT)
- Example hazards

3. CAUSAL METHODS/MODELS

- Causal methods/models
- Purpose and problems
- Recommendations and Relation to New Technologies
- Failure Modes and Effects Analysis (FMEA)
- Root Cause Analysis (RCA)
- Common Cause Analysis (CCA)
- Ishikawa Diagram (Fishbone Diagram)
- Probabilistic Risk Assessment
- Fault Tree Analysis (FTA)
- Event Tree Analysis (ETA)
- Bow Tie
- Bayesian Belief Networks (BBN)
- Petri Nets (PN)
 - Elementary Petri Nets
 - Time Petri Nets
 - Coloured Petri Nets
 - Stochastically and Dynamically Coloured Petri Nets

4. COLLISION RISK METHODS/MODELS

- Collision risk methods/models
- Reich-Marks model

- Other models
 - Machol-Reich model
 - Intersection models
 - Geometric conflict models
 - Generalized Reich model
- Purpose and problems
- Recommendations and Relation to New Technologies
- ICAO Collision Risk Model (CRM)
- Application of the collision risk model
- Framework for airspace planning and design based on conflict risk assessment
 - Conflict Risk Assessment Model for Airspace Strategic Planning
 - Conflict Risk Assessment Model for Airspace Tactical Planning
 - Conflict Risk Assessment Model for Airspace Operational and Current Day Planning

5. HUMAN ERROR MODELS

- Human error models
- Hazard and Operability (HAZOP)
- Human Error Assessment and Reduction Techniques (HEART)
- Technique for the Retrospective Analysis of Cognitive Errors (TRACER-Lite)

- Human Factor Analysis and Classification System (HFACS)
- Human Error and Safety Risk Analysis (HESRA)
- Human Error in ATM (HERA)
- Purpose and problems
- Recommendations and Relation to New Technologies

6. THIRD PARTY RISK MODELLING

- Third Party Risk (TPR) Modelling
- TPR calculations
 - USA case
 - The Netherland case
 - UK case
- Purpose and problems
- Recommendations and Relation to New Technologies
- Application of the TPR models

7. ACCIDENT MODELLING APPROACHES

- Accident Modelling Approaches
- Sequential Accident Models
- Epidemiological Accident Models
- Systemic Accident Models
- Formal Methods and Accident Analysis

- Resilience Engineering
- Systems-Theoretic Accident Model and Processes model (STAMP)
- Functional Resonance Accident Model (FRAM)

8. CONFLICT DETECTION AND RESOLUTION METHODS

- Safety barriers
- Conflict Detection and Resolution (CD&R) Methods
- Airborne vs. Ground CD&R
- Required Information
- Conflict Detection
- Conflict Resolution
- TCAS example

References

Author Biography

