# as Science-to-Business

S2B

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# From Fundamental Research to Practical Solutions



### Prof. Dr. Ivan Kisel

**Research Area:** Computer Sciences and AI Systems **Focuses:** High Performance Computing, Nuclear Physics

#### 🖌 Who We Are?

- We develop fast online algorithms combining analytical methods and AI/ML for real-time data processing in heavy-ion physics experiments. These algorithms have been successfully applied in ALICE (CERN), CBM (FAIR/GSI), and STAR (BNL).
- We also develop AI algorithms for process optimization and predictive analytics in transportation, logistics, finance and forecasting to improve efficiency and reduce risk.
- Our solutions use advanced models including Graph Neural Networks (GNN), Transformers and hybrid AI algorithms.

### 📌 Key AI Technologies:

- Transformers and self-attention for time series analysis
- **Reinforcement Learning (RL)** for adaptive decision making in dynamic environments
- Graph Neural Networks (GNN) for traffic flow optimization
- Bayesian Neural Networks (BNN) for uncertainty-aware prediction
- ...

# 📌 Our Goal:

Bringing science and industry together for innovation by developing AI technologies that turn complex data into business solutions.

# AI for Smart Transportation and Logistics

#### **1. Green-Wave City:** AI for Adaptive Traffic Lights

- **Problem:** Traffic congestion and inefficient traffic management.
- Solution: AI-driven real-time traffic light phase optimization.
- Technologies: GNN, Reinforcement Learning (DQN, PPO), Time Series Prediction (LSTMs + Transformers).
- **Outcome:** 30% congestion reduction, lower CO<sub>2</sub> emissions.
- **Partners:** Municipalities, transport companies.
- https://ann2thrive.com/die-stadt-der-gruenen-wellen/

#### 🚔 2. Intelligent Navigation: AI-Powered Traffic Routing

- **Problem:** Sub-optimal routes, congested roads, and real-time navigation challenges in heavy traffic.
- Solution: AI models predict traffic and suggest optimal routes, solving the navigation problem in heavy traffic conditions in real-time.
- Technologies: Graph Attention Networks (GAT), Multi-Agent Reinforcement Learning (MARL), Transformer-based traffic prediction.
- Outcome: Reduced fuel consumption, reduced travel time.
- **Partners:** Logistics companies, car manufacturers.
- <u>https://ann2thrive.com/intelligentes-fahrzeug-navigationssystem/</u>

#### **3. AI Logistics for E-commerce:** Same-Day Delivery

- **Problem:** High cost and slow delivery.
- Solution: AI-driven optimization of routing, including emergency vehicles, also using drones for rapid delivery of medical and critical goods.
- Technologies: Hybrid AI models (LSTMs + Reinforcement Learning), Dynamic Vehicle Routing AI, Federated Learning.
- **Outcome:** Faster delivery, reduced logistics costs.
- **Partners:** E-commerce companies, logistics operators, transportation services, emergency services (ambulance, fire, police).
- <u>https://ann2thrive.com/ecommerce-am-selben-tag/</u>

# AI for Risk Analysis, Finance, and Cybersecurity

#### **4. AI Strategies for the Stock Market:** Markets and Investments

- **Problem:** High uncertainty and instability in the stock market.
- Solution: AI-driven financial data analysis and trend detection, analysis of financial publications, reports, and other text sources to predict risks.
- Technologies: NLP-based financial document analysis, Transformers for financial time series, Reinforcement Learning (Deep Q-Networks).
- Outcome: Market trend predictions through analysis of financial publications and reports, improved forecasting accuracy, reduced investment risks.
- **Partners:** Banks, investment funds.
- https://ann2thrive.com/zeitnahe-strategien-fuer-die-boerse/

#### 5. AI Against Financial Fraud: Fraud Detection

- **Problem:** Increasing fraud in banking and credit transactions.
- Solution: AI models analyze transactions and detect anomalies.
- Technologies: Transformer-based NLP and anomaly detection, Graph Neural Networks (GNN) for transaction network analysis.
- **Outcome:** Increased security of financial transactions.
- **Partners:** Banks, payment systems, insurance companies.
- <u>https://ann2thrive.com/transformers-gegen-betrug/</u>

#### **6. AI-Based Uncertainty Prediction:** Measurement Error Propagation

- **Problem:** Lack and inaccuracy of data for decision making.
- Solution: Propagate measurement errors throughout the neural network architecture to provide not only a prediction but also its accuracy.
- Technologies: Bayesian Neural Networks (BNN), Uncertainty Quantification (UQ) to propagate uncertainty throughout the model.
- Outcome: More accurate predictions with confidence intervals, improved decision making under conditions of incomplete and imprecise data.
- **Partners:** Logistics, health care, insurance, financial sector, high-tech industry.
- <u>https://ann2thrive.com/ki-vorhersagen-unter-unsicherheit/</u>

# How Can We Work Together?



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### 📌 Why is this important?

- AI solutions reduce costs, increase efficiency and improve predictive accuracy.
- We bridge science and business by developing innovative AI algorithms.

## 📌 Collaboration opportunities:



V Implementation of AI solutions in pilot projects

- V Development of new AI models
- **V** Joint funding applications

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