UNIVERSITY OF TARTU
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Computer Science Curriculum

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Soft Computing Approaches for Wireless Localization

Bachelor's Thesis (9 ECTS)

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Soft Computing Approaches for Wireless Localization

Abstract:

Localization algorithms in wireless sensor networks have been an interesting field of research for the past few years. The combination of different requirements such as storage space, computational capacities, communication capabilities, and power efficiency make it challenging to develop a localization algorithm. One subcategory of localization algorithms is neural network based algorithms where a model is trained on data from anchor nodes.

In this thesis, the fuzzy transform is introduced into the context of existing neural network-based localization algorithms. The fuzzy transform is proposed as a replacement for dimensionality reduction methods in the algorithms. Before feeding the data into the neural network for the purpose of training, its dimensionality needs to be reduced as it is the main factor of performance. The performance of the fuzzy transform compared to the full dataset and a common reduction method principal component analysis is evaluated by testing on simulated data. The obtained results show that the proposed fuzzy transform based approach outperforms principal component analysis in localization accuracy while being comparable in neural network training time. The fuzzy transform performed comparably or slightly worse with the full dataset in localization accuracy, but showed much shorter training times.

Keywords:
Machine learning, Fuzzy transform, Reduction techniques

CERCS: P170 Computer science, numerical analysis, systems, control

Hägusloogika rakendus asukoha määramiseks

Lühikokkuvõte:

Juhtmevabade andurivõrkude lokaliseerimisalgoritmid on viimastel aastatel olnud huvitav uurimisvaldkond. Erinevate nõuete, näiteks salvestusruumi, arvutusvõimsuse, kommunikatsioonivõime ja energiatõhususe kombinatsioon muudab lokaliseerimisalgoritmi väljatöötamise keeruliseks. Üks lokaliseerimisalgoritmide alamkategooria on närvivõrgu põhised algoritmid, kus närvivõrku treenitakse ankuranduritelt saadud andmetega.

Käesolevas bakalaureusetöös on olemasolevate närvivõrgu-põhiste lokaliseerimisalgoritmide kontekstis kasutatud hägusteisendust. Hägusteisendust pakutakse asenduseks algoritmide dimensioonilisuse vähendamise meetoditele. Enne närvivõrgu treenimist andmetel tuleb andmete dimensioonilisust vähendada, kuna see on peamine tegur, mis mõjutab algoritmi tulemuslikkust. Hägusteisenduse tulemuslikkust võrreldakse algsete andmete ja kasutusel oleva dimensionaalsuse vähendamise meetodi peakomponentide

analüüsi vastu läbi testimise simuleeritud andmetel. Saadud tulemused näitavad, et hägusteisenduse kasutus pakub paremat lokaliseerimistäpsust kui peakomponentide analüüs kulutades sarnast aega närvivõrgu treenimisel. Hägusteisendus pakub sarnast või veidi madalamat lokaliseerimistäpsust kui algandmete kasutamine, aga närvivõrgu treenimine toimub palju kiiremini.

Võtmesõnad:
Masinõpe, Hägusteisendus, Taandusmeetodid

CERCS: P170 Computer science, numerical analysis, systems, control

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