



Initialize swarm of particles

$t=1$   
while not converged do

for each particle,  $\mathcal{P}_j$ , do

$$v_j^i(t) = w_j^i v_j^i(t-1) + c_1 r_1^i (p_{j1}^i - x_j^i(t-1)) + c_2 r_2^i (p_{j2}^i - x_j^i(t-1)) + \mu_j^i(t)$$

$$x_j^i(t) = x_j^i(t-1) + v_j^i(t)$$

end for

$$x_j^i(t) \sim U(0, 1)$$

$$N(0, \sigma_j^2(t))$$

$$d_j = |g_{j1}(k-1) - g_{j2}(k-1)|$$

$$\vec{v}_j^i(t)$$

$$\vec{p}_{j1}^i$$

$$\vec{p}_{j2}^i$$

# Prof Andries Engelbrecht

Prof Engelbrecht is professor en Hoof van die Departement Rekenaarwetenskap in die Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie. Hy beklee die SARChI-leerstoel in Kunsmatige Intelligensie. Sy belangrikste navorsingsfokus is op rekenaarintelligensie met 'n spesifieke belangstelling in swermintelligensie, algoritmiese modellering van evolusie, kunsmatige neurale netwerke, kunsmatige immuunstelsels en leer vanaf 'n beginpunt van nul-kennis deur kompeterende ko-evolusie te gebruik. Algoritmiese modelle van hierdie verskynsels uit die natuur word aangewend om komplekse optimeringsprobleme op te los, met inbegrip van probleme waar die soeklandskap dinamies met tyd verander en waar veelvuldige botsende doelwitte gelyktydig geoptimeer moet word.

Prof Engelbrecht se werk op die terrein van partikelswermoptimering (PSO), gegrond op modelle ontleen aan die gedrag van voëls wat swerms vorm, het betekenisvolle erkenning gekry. Sy groep se navorsing was die eerste wat daarin geslaag het om konvergensie bewyse vir PSO-algoritmes te voorsien, nuwe PSO-algoritmes te ontwikkel wat veelvuldige oplossings in hoogs multimodale landskappe kan vind en naspour, PSO te gebruik om neurale netwerke af te rig in die teenwoordigheid van konseptuele drywing, PSO aan te wend om die probleem van die voorspelling van die sekondêre struktuur van RNS op te los en om die tekortkominge van PSO-algoritmes te identifiseer en op te los.

Baanbrekerswerk is gedoen met die ontwikkeling van PSO-algoritmes om binêre waarde-optimeringsprobleme in kontinue waarde-ruimtes met 'n vaste klein dimensie op te los, ongeag die dimensie van die binêre waarde-optimeringsprobleem. Die eerste doeltreffende PSO-algoritmes is ontwikkel om optimeringsprobleme op te los waar die oplossings uitgedruk word deur wiskundige versamelings in plaas van vektore te gebruik. Nuwe PSO-algoritmes is ook ontwikkel om dinamiese optimeringsprobleme met veelvuldige doelwitte op te los. Prof Engelbrecht geniet erkenning vir sy werk met samewerkende en mededingende ko-evolusionêre PSO-algoritmes waarvan laasgenoemde gebruik word om besluitnemers vanaf 'n beginpunt van nul-kennis op te lei. Prof Engelbrecht beskik oor 'n B2-gradering van die NNS.

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Prof Engelbrecht is a professor and Head of the Department of Computer Science in the Faculty of Engineering, Built Environment and Information Technology. He holds the South African Research Chairs Initiative (SARChI) Chair in Artificial Intelligence. His main research focus is in computational intelligence, with a particular interest in computational swarm intelligence, evolutionary computation, artificial neural networks, artificial immune systems, and learning from zero-knowledge using competitive co-evolution. Algorithmic models of these phenomena from nature are applied to solve complex optimisation problems, including problems where the search landscape dynamically changes over time, and where multiple conflicting objectives have to be simultaneously optimised.

Prof Engelbrecht's work on particle swarm optimisation (PSO), based on models of bird-flocking behaviour, has received significant recognition. His research group was the first to provide convergence proofs for PSO algorithms, develop new PSO algorithms to locate and track multiple solutions in highly multimodal landscapes, train artificial neural networks in the presence of concept drift using PSO, solve the RNA secondary structure prediction problem using PSO, and to identify deficiencies of PSO algorithms and how to solve these. Ground-breaking work was done with the development of PSO algorithms to solve binary-valued optimisation problems in continuous-valued space with a fixed small dimension, irrespective of the dimension of the binary-valued optimisation problem.

The first, efficient PSO algorithms were developed to solve optimisation problems where solutions are represented using mathematical sets instead of vectors. New PSO algorithms have also been developed to solve dynamic multi-objective optimisation problems. Prof Engelbrecht is well-recognised for his work on cooperative and competitive co-evolutionary PSO algorithms, with the latter applied to train decision-makers from zero-knowledge. Prof Engelbrecht holds a B2-rating from the NRF.

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Prof Engelbrecht ke moprofesa ebile ke Hlogo ya Kgoro ya Thutamahlale a Dikhomphutha ka Lefapheng la Boentsenere, Kagotikologo le Theknolotši ya Tshedimošo. O swere maemo a Bodulasetulo bja Bohlami bja badulasetulo bja bonyakisiši ba Afrika-Borwa go Saense ya Maitirelo. Šedi ya gagwe ya dinyakisišo e go saense ya dikhomphutha, kudukudu mo go saense ya seboka ya khomphutha, tlhamegoleswa ya sekhomphutha, mararankodi a maitirelo a dinyurone, disestemo tša bothibelamalwetši tša maitirelo, le go ithuta go tšwa go tlhokatsebo go šomišwa tlhamoleswammogo ye e phadisanago. Dimmotlolo tša tatelano ya go balela tša dikgopolo tše tša go tšwa tlhagong di a šomišwa go rarolla mathata ao a raraganego a kgetho ya dielemente go balwa le mathata ao go ona ponagalo ya naga e fetogago ka go raragana ge nako e tšwela pele, le moo merero ye mentši yeo e thulanago e swanetšego go phethagatšwa ka nako e tee.

Mošomo wa Prof Engelbrecht wa PSO wo o ithekgilego ka maitshwaro a bogongwane bja dinonyana, o filwe temogo ya maemo a godimo. Sehlopha sa gagwe sa dinyakisišo se bile sa mathomo go tšweletša bohlatse bja kopano bakeng sa ditatelano tša PSO, go godiša ditatelano tše diswa tša PSO go hwetša le go lotišiša ditharollo tše mmalwa ka diponagalong tša dibopegontši, go hlaha mararankodi a maitirelo a dinyurone ka go beng gona ga moelakgopolo go šomišwa PSO, go rarolla mathata a taolo ya sebopego sa bobedi sa RNA go šomišwa PSO, le go laetša ditlhaelelo tša ditatelano tša PSO le ka fao tše di tloga rarollwa. Mošomo wo mobotše o dirilwe ka tlhabollo ya ditatelano tša PSO go rarolla mathata a boleng bja go menagana bokaone ka sekogobeng sa go tšwela pele go ba le mohola ka tekanyo ye nnyane ya go se fetoge, go sa šetšwe gore tekanyo ya boleng bja go menagana bokaone ke efe.

Ditatelano tša mathomo tša go ba le bokgoni di dirilwe go rarolla mathata a bokaone fao ditharollo di tšweletšwago ka go šomišwa disete tša dipalo sebakeng sa dibekthara. Ditatelano tše diswa tša PSO gape di dirilwe go rarolla mathata a maikemišetšobokaone a mantši ao a fetogago. Prof Engelbrecht o tsebega kudu ka mošomo wa gagwe wa ditatelano tša PSO tša phetogommogo ya phadišano le tšhomišano, fao ye ya mafelelo e dirišwago go hlaha batšeadiphetho go tloga seemong sa go hloka tsebo. Prof Engelbrecht o na le maemo a B2 go tšwa go NRF.