

ANN-based prediction of equilibrium gas composition and carbon yield in methane pyrolysis and reforming methods

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Figures 1-15 present parity plots for all cases listed in Table 2 of the article.

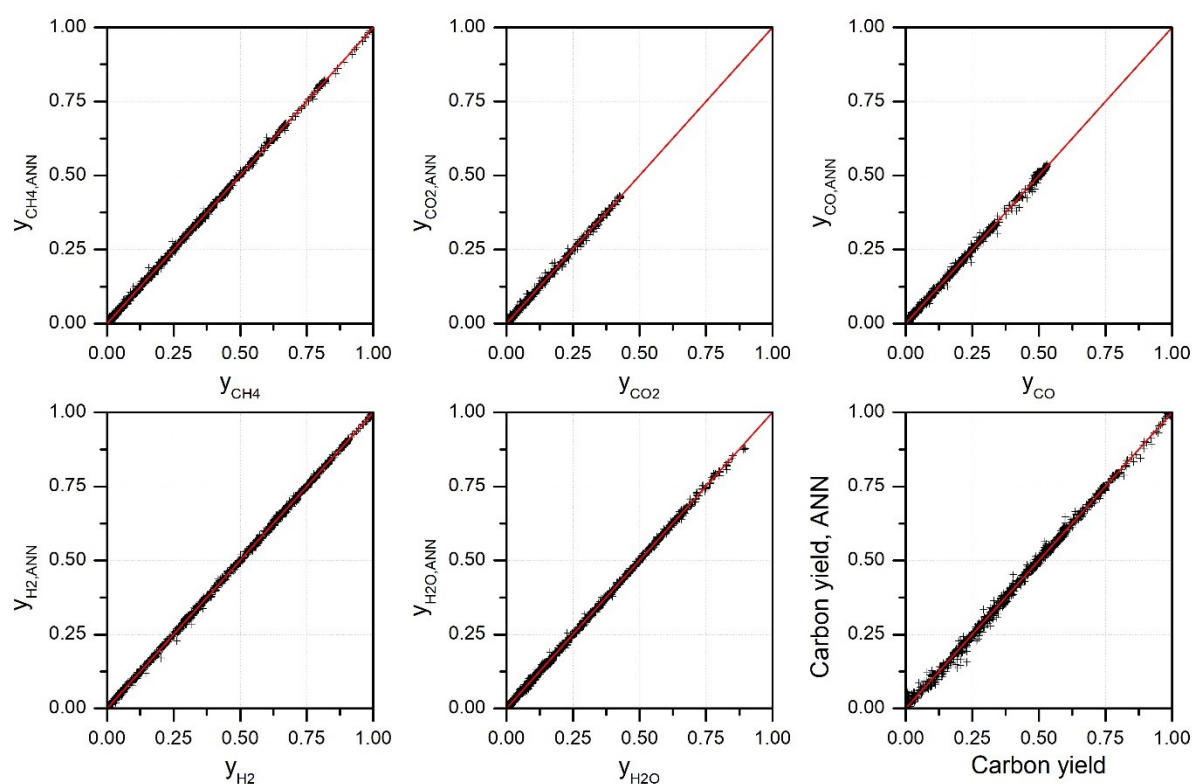


Fig. 1. Comparison of the ANN predictions and targets for training/testing set No. 1 (see Table 2 and Table 3).

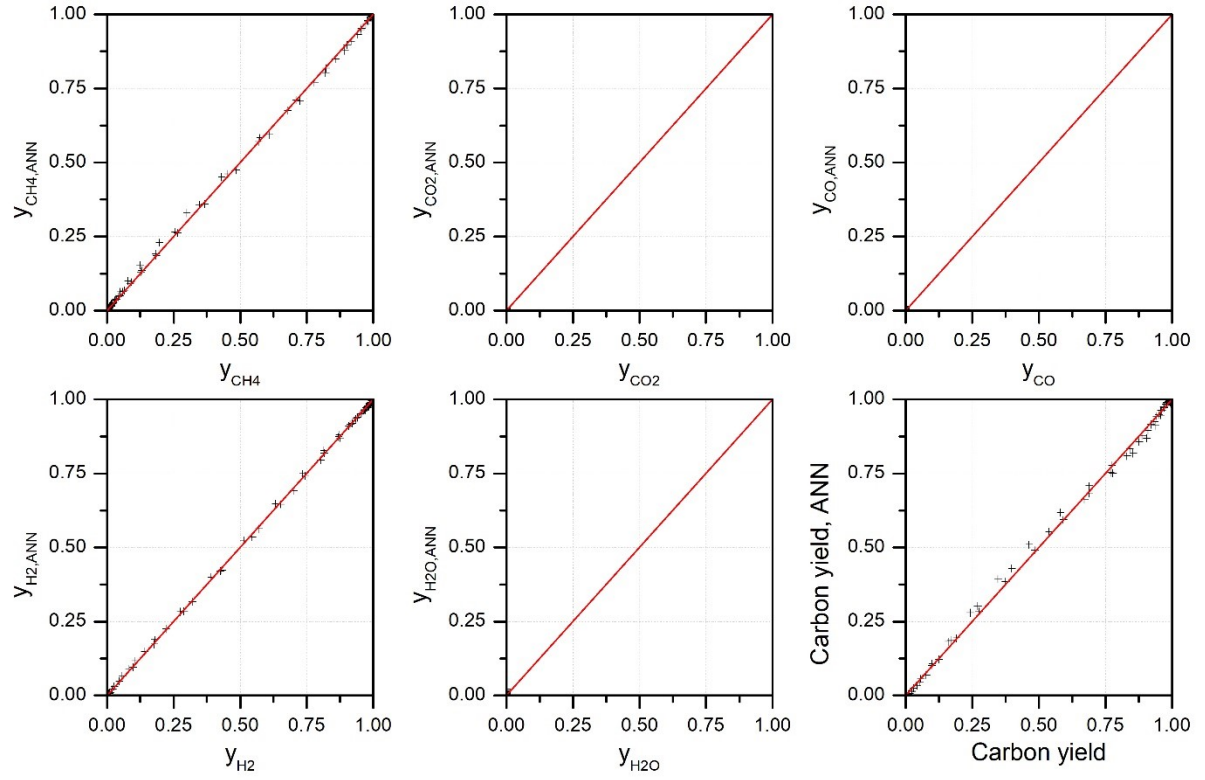


Fig. 2. Comparison of the ANN predictions and targets for testing set No. 2.1 (see Table 2 and Table 3).

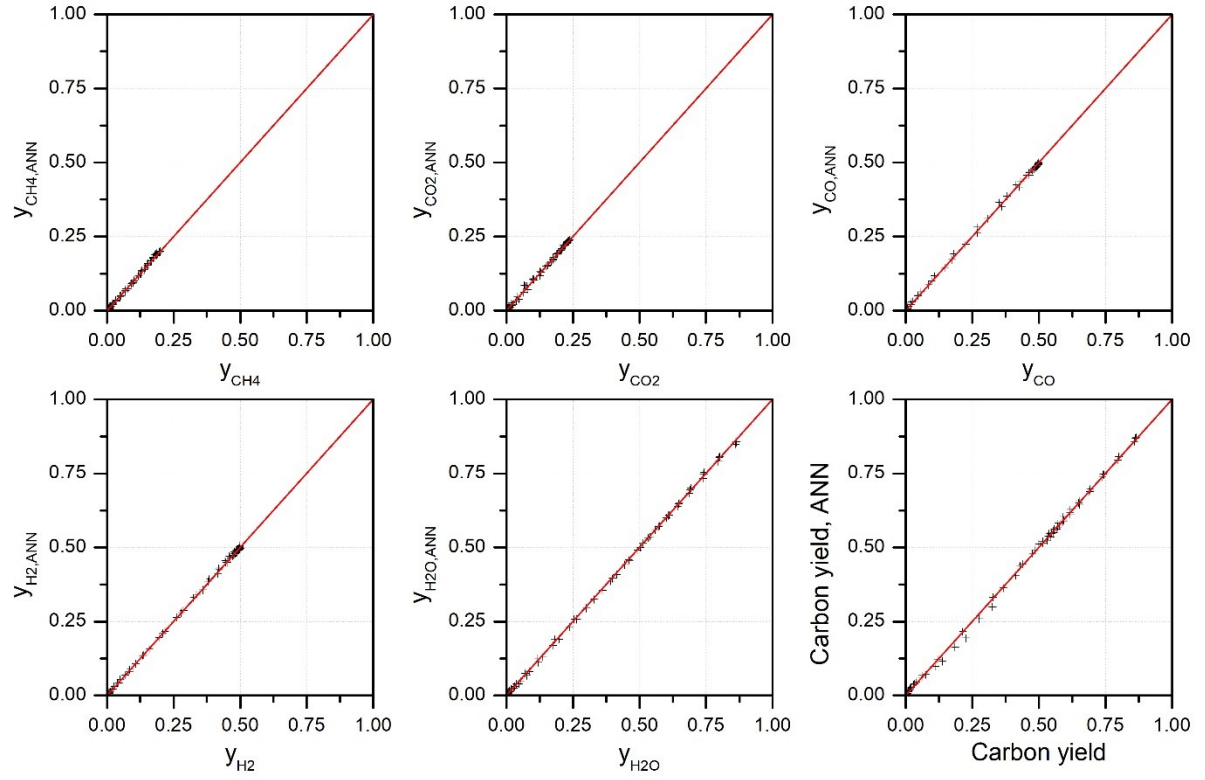


Fig. 3. Comparison of the ANN predictions and targets for testing set No. 2.2 (see Table 2 and Table 3).

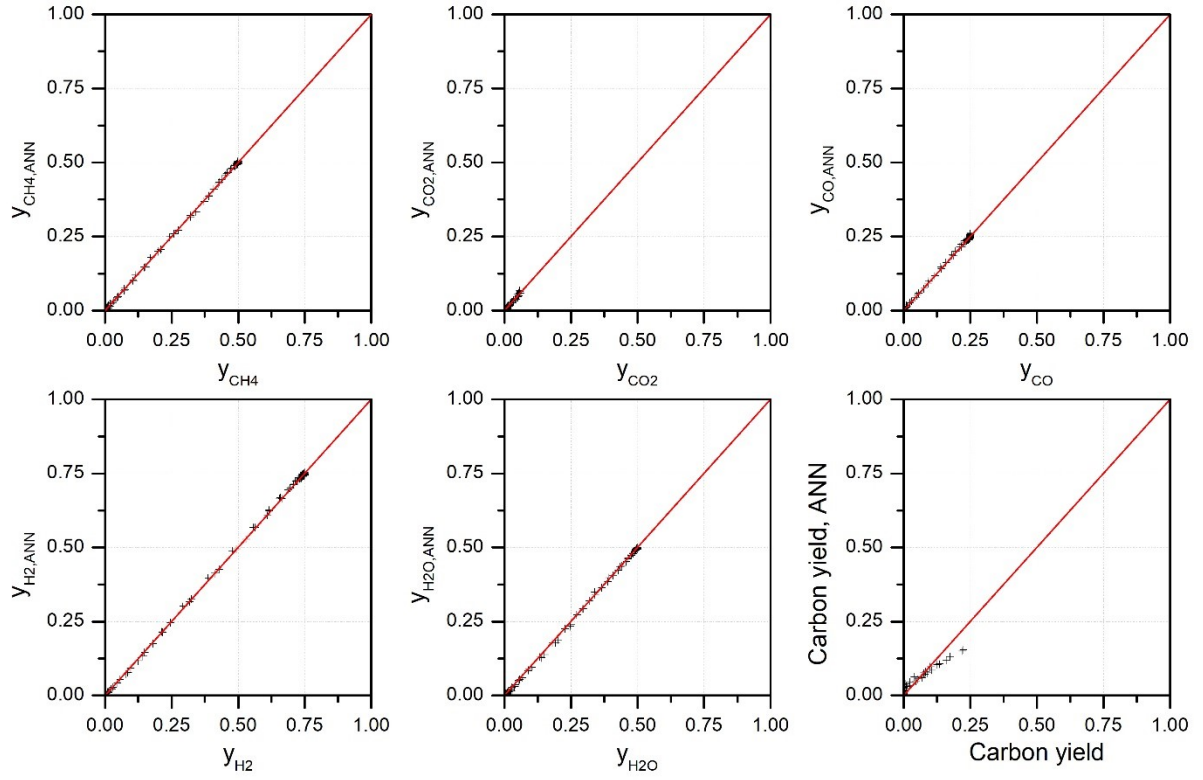


Fig. 4. Comparison of the ANN predictions and targets for testing set No. 2.3 (see Table 2 and Table 3).

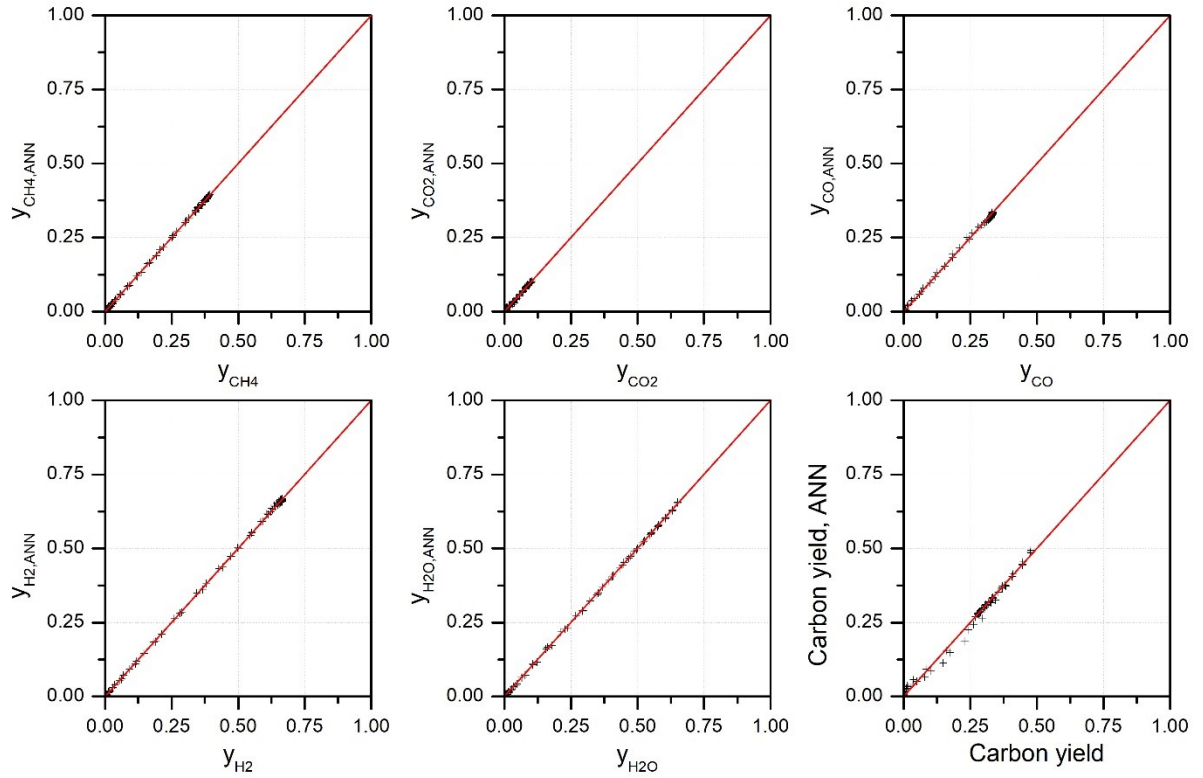


Fig. 5. Comparison of the ANN predictions and targets for testing set No. 2.4 (see Table 2 and Table 3).

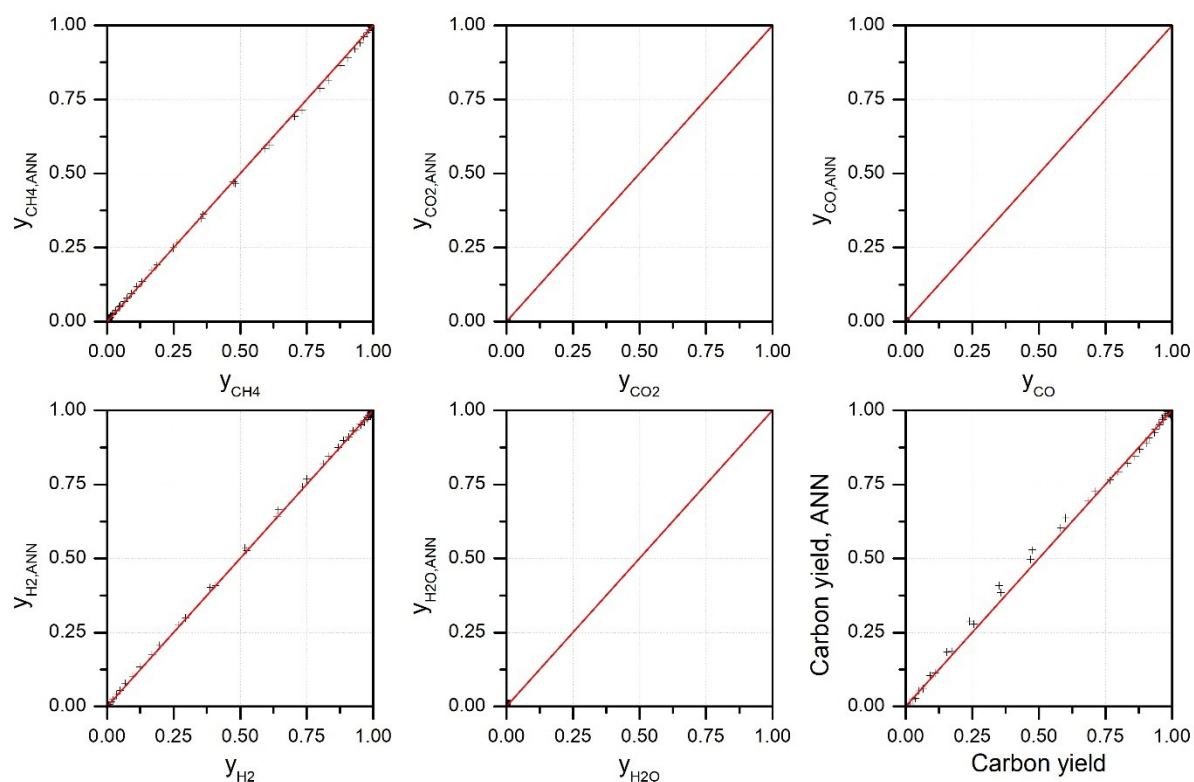


Fig. 6. Comparison of the ANN predictions and targets for testing set No. 3.1 (see Table 2 and Table 3).

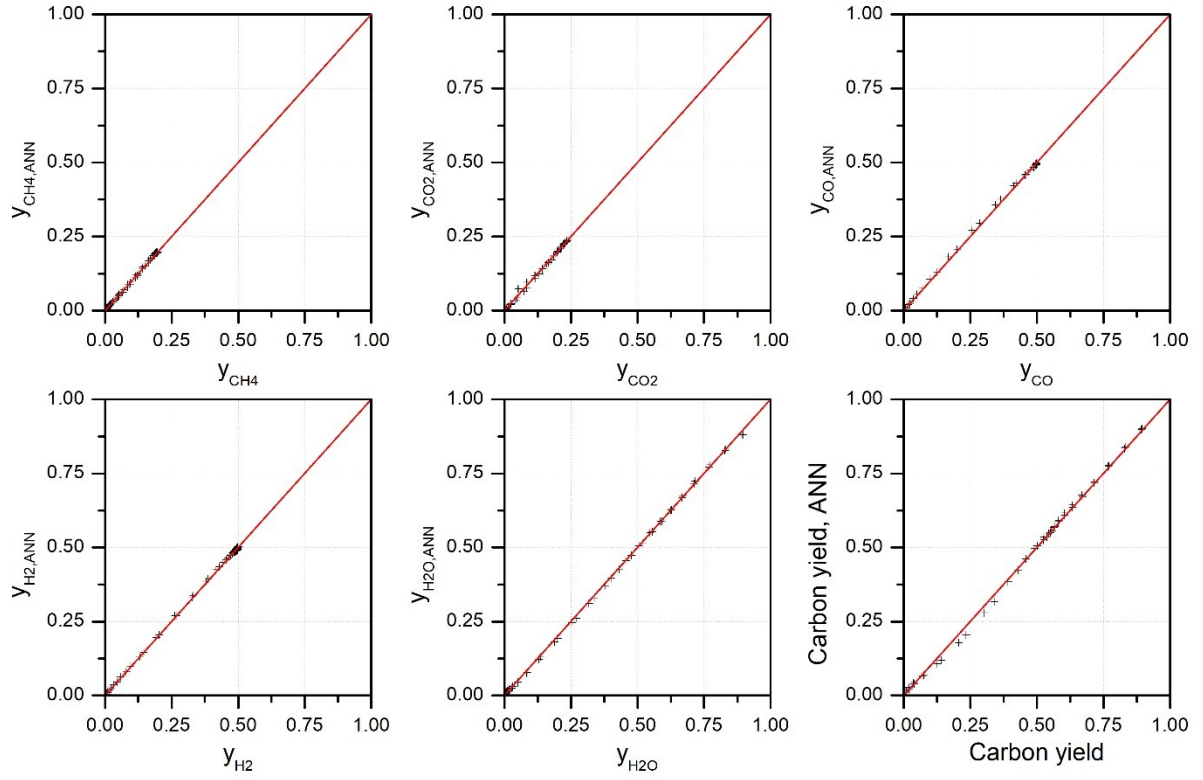


Fig. 7. Comparison of the ANN predictions and targets for testing set No. 3.2 (see Table 2 and Table 3).

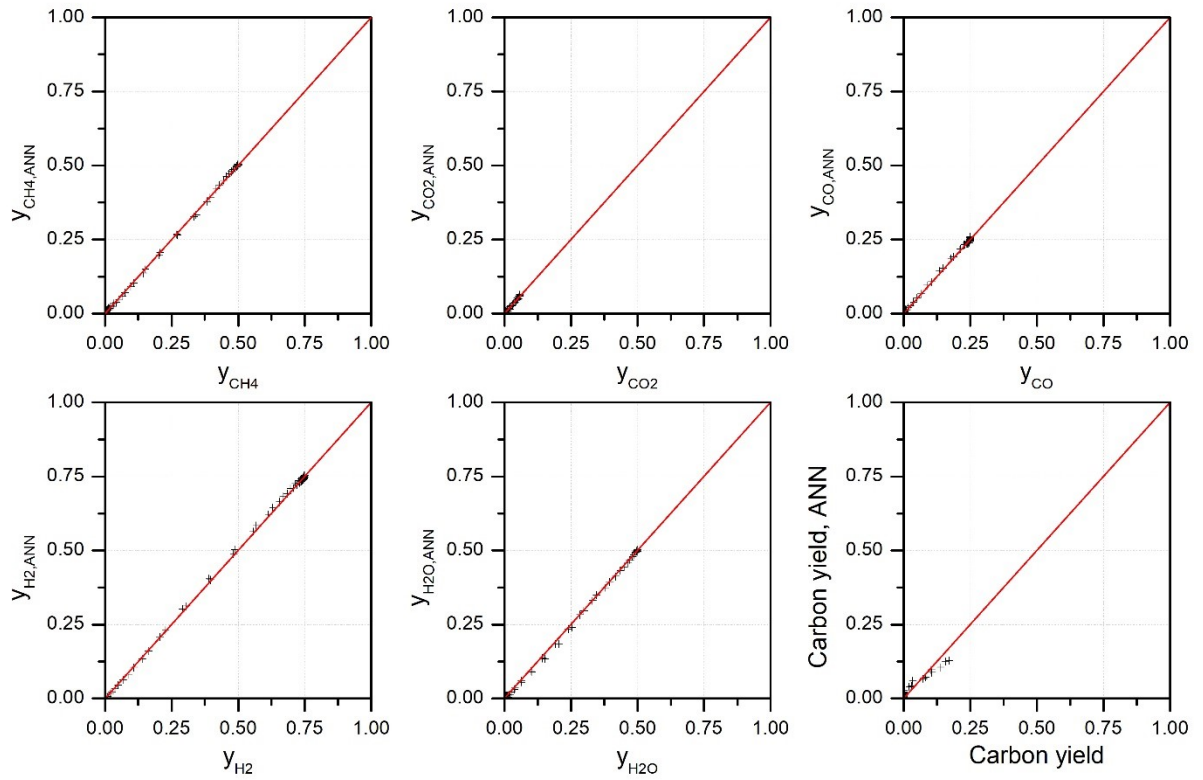


Fig. 8. Comparison of the ANN predictions and targets for testing set No. 3.3 (see Table 2 and Table 3).

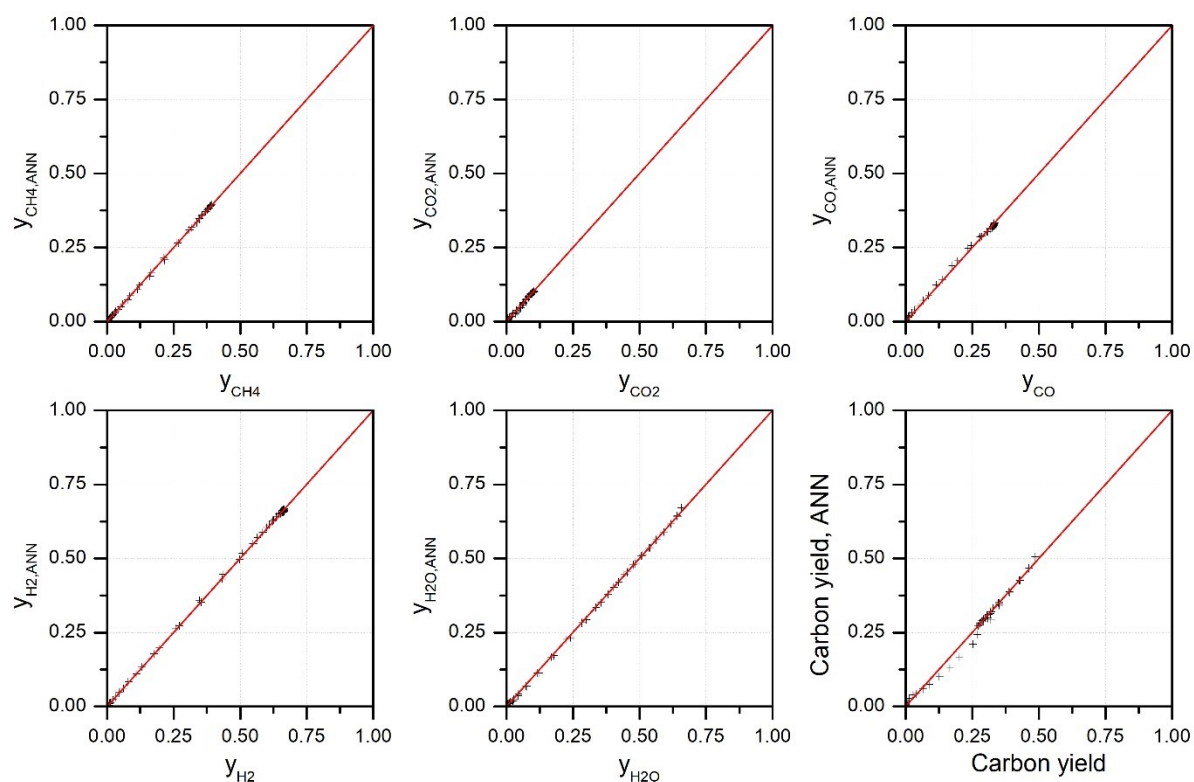


Fig. 9. Comparison of the ANN predictions and targets for testing set No. 3.4 (see Table 2 and Table 3).

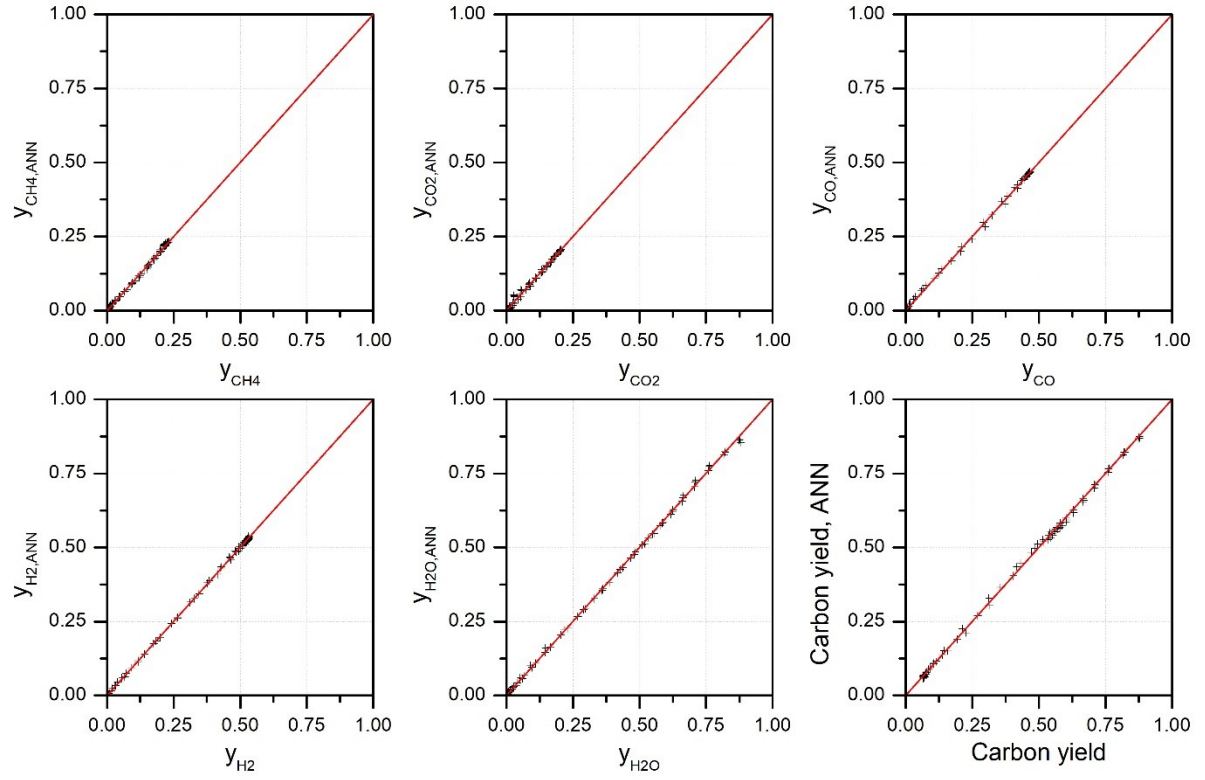


Fig. 10. Comparison of the ANN predictions and targets for testing set No. 4.1 (see Table 2 and Table 3).

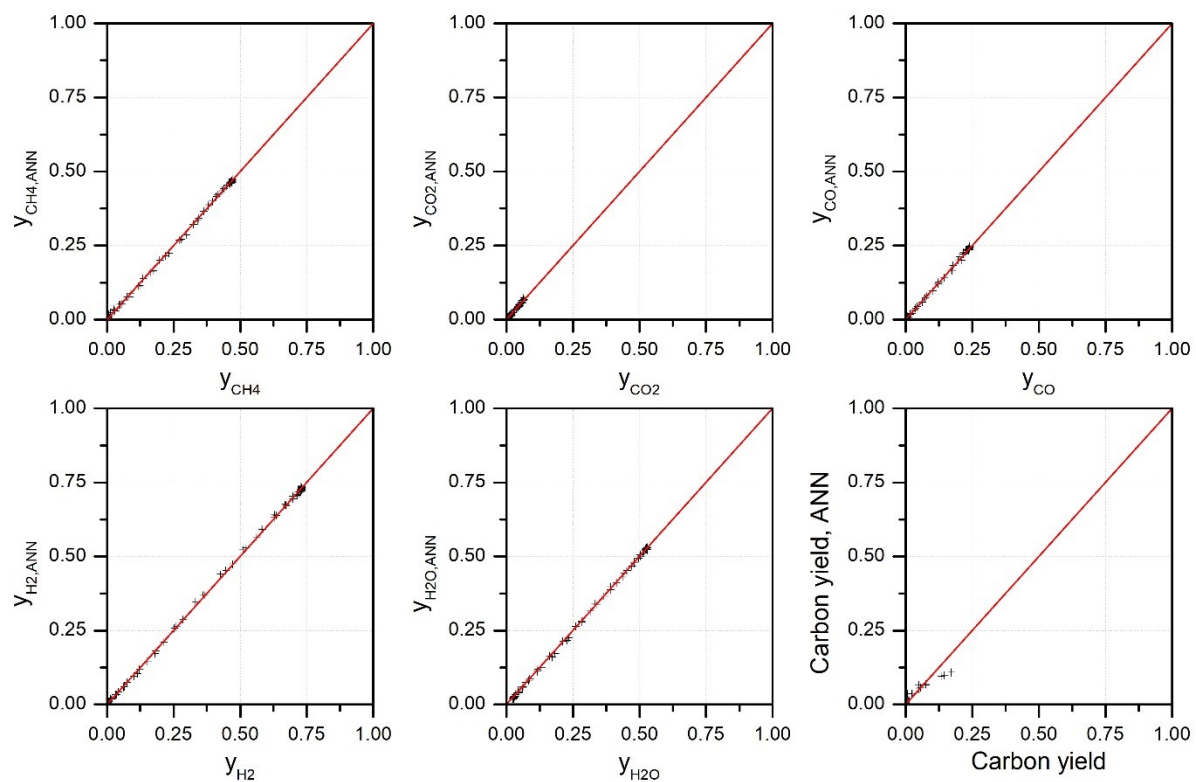


Fig. 11. Comparison of the ANN predictions and targets for testing set No. 4.2 (see Table 2 and Table 3).

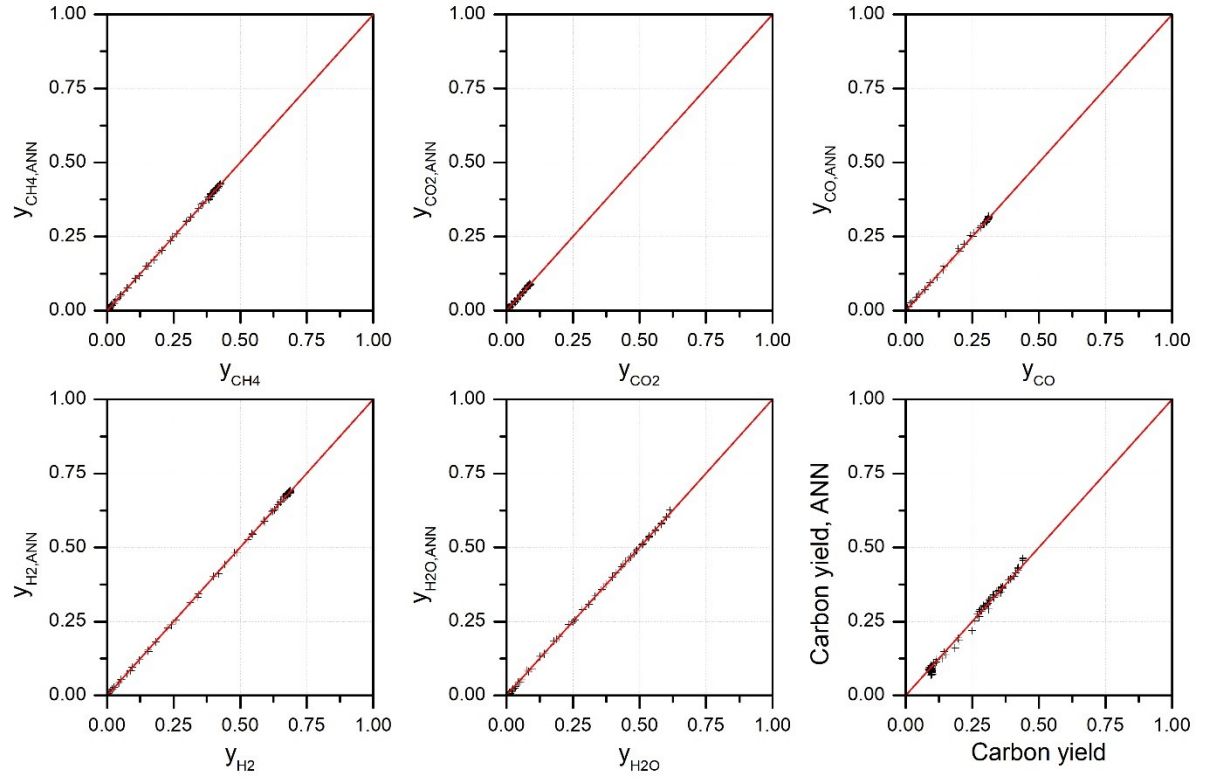


Fig. 12. Comparison of the ANN predictions and targets for testing set No. 4.3 (see Table 2 and Table 3).

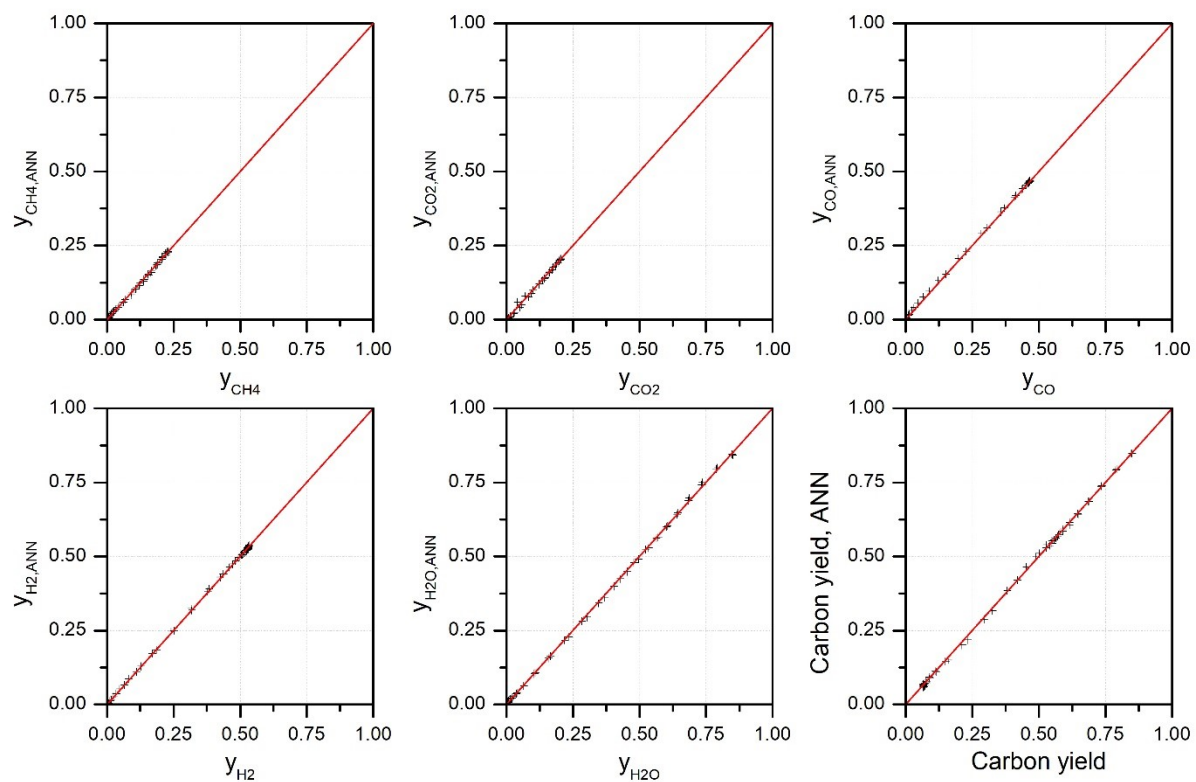


Fig. 13. Comparison of the ANN predictions and targets for testing set No. 5.1 (see Table 2 and Table 3).

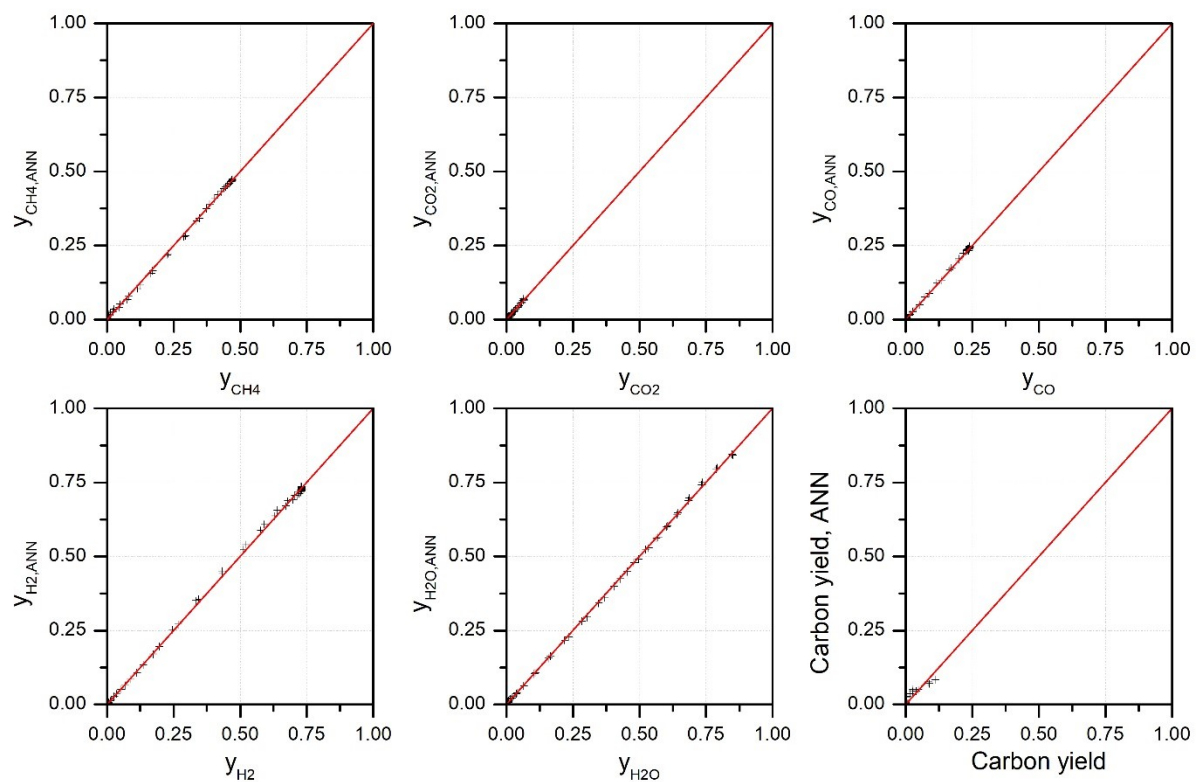


Fig. 14. Comparison of the ANN predictions and targets for testing set No. 5.2 (see Table 2 and Table 3).

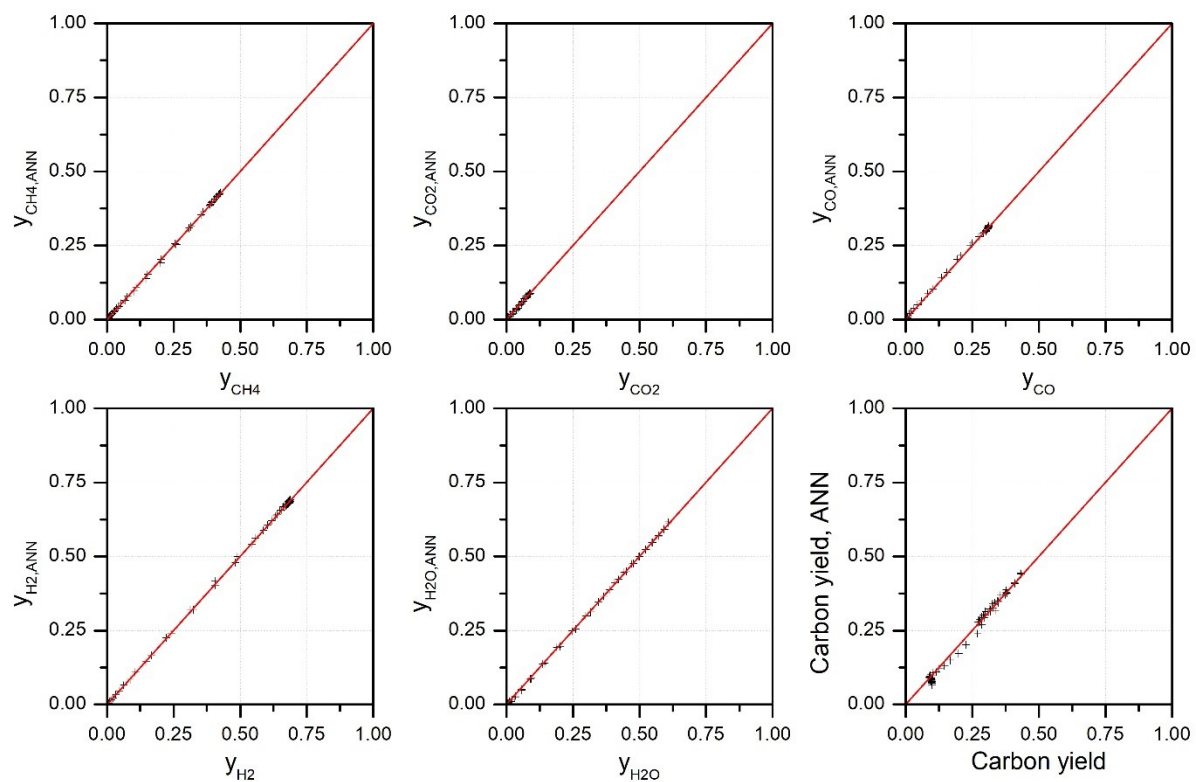


Fig. 15. Comparison of the ANN predictions and targets for testing set No. 5.3 (see Table 2 and Table 3).

Tables 1 and 2 present the ANN weights to allow researchers and engineers to directly incorporate the network in their own equilibrium calculations.

Table 1. Trained ANN parameters (synaptic weights) between the input and hidden layers. The ANN architecture consists of 5 input neurons, 40 hidden neurons, 6 output neurons. A weight denoted as $w_{i,1}$ represents the weight between the 1st input neuron and the i -th hidden neuron.

Neuron in the hidden layer	Weights					
	$w_{i,1}$	$w_{i,2}$	$w_{i,3}$	$w_{i,4}$	$w_{i,5}$	<i>Bias, b_i</i>
h1	-0.907916594355117	3.27164337681703	-0.646014543821406	-0.391759794370049	0.0113785050484542	3.23362447078554
h2	0.233888656335413	-0.802878768033799	-0.255414555342880	1.60904032173777	-0.0638868419900793	-1.12342315511847
h3	-1.82176802901100	2.20156124360395	0.460394192771420	1.58803747808628	-0.0558969578482696	2.14729376321574
h4	-0.817919696409531	-0.636046129330957	-0.236400772728905	-0.892326731280514	0.0499429632750684	0.0716033306655599
h5	-0.00463163004009975	-0.0940992351490791	-0.0551306150626950	3.88063379676678	-0.555468110691581	1.20483908290581
h6	0.289620144929912	-1.90293718883560	0.366572254703279	-1.93671788410678	0.0800830104155484	-2.77383319079088
h7	-0.996903547683568	1.40652600753122	-0.325727857110446	1.04092998917673	-0.0488533181124923	1.31102211588350
h8	1.47362416386804	-0.736280095152739	-0.627712596222488	-2.33703114890844	0.170004455949834	-0.447315042195127
h9	-0.357819710360007	-1.31850720210538	1.44955111693982	6.38062879142763	-0.275699414177476	-0.627228112694745
h10	-0.692401340646491	-0.119679585969223	-0.261774737418889	-0.0744039566288533	-0.0247923766302907	-0.310288224999099
h11	-0.505537540252708	0.838924398195542	-0.109850649754864	-1.30346513579911	0.0587906060205587	0.279373789101517
h12	-1.60219888884069	-0.779036855562251	0.621954236208683	-0.146862533993421	0.0158758688702985	-2.84020026768637
h13	-0.786357167608458	-0.549075735714840	0.137803386021561	0.104222601561373	-0.0124934085464774	-0.489659508921158
h14	-0.317791965779301	0.187592474521780	0.497834027422262	1.17068161962566	-0.0427603059628430	1.96906049840988
h15	-0.624188707389903	0.613823204416107	0.173951580661364	-0.433802291935491	0.0229854849023079	0.859959635225104
h16	-0.953064090305814	0.285844690234204	0.302921186970266	0.557147629783008	-0.0258011508868561	0.610269569702080
h17	-4.01735533924013	-1.48389108597893	0.757575533338392	-3.02605886501401	0.110412119413734	-3.70895537496714
h18	1.30421787960528	-0.791382579371810	-0.719191023420299	-2.26786408241034	0.159452835606870	-0.590291274402322
h19	1.48112830812510	0.504355107786945	-0.160366432576766	4.95535956139158	-0.216800982553719	1.69476410536800
h20	1.01265487337338	0.0127660647855559	0.261130322846380	1.41266935591108	-0.0255515252718367	1.56317412206824
h21	-0.397287704052370	-0.511685207805294	0.364371808794868	4.80559832495778	-0.227651713342158	0.768777110622065
h22	0.0294556974682000	-0.0862779469038370	0.0171595467544728	-1.44880456553811	1.86209342792158	0.973497557186155
h23	-4.06721781854235	-4.23976346718231	-3.00305380868885	-0.244305321970234	0.0139350814920136	-7.01184602317433
h24	-0.103771541186437	-0.290861750868278	-0.417744987738591	1.00940562004899	-0.0361169324774693	-0.0711775998756274
h25	-1.77646472775514	-0.456296158451212	-0.976385568038365	1.62970047202742	-0.0703176795048643	-1.98691600551182
h26	0.0667880517885743	-0.0553678361846921	-0.0297090002148904	3.73251063368874	-0.452398211217646	1.12862269910376

h27	-1.20594963691550	0.570188502090267	-0.331849879781812	-3.81257156617932	0.164517782083781	-2.14744577621522
h28	2.29988879191104	-0.813138142403438	-1.16115449757146	-1.18543024995594	0.0539754088814550	1.27764794667838
h29	0.315321436654600	0.0853784328292868	-1.31003638889946	1.66865315265125	-0.0629888754480656	0.596212269029805
h30	-2.89801908877911	-0.0720146716612561	0.0172426143492057	0.593006773261278	0.455006530726976	-3.28792715113439
h31	-1.79259305692103	4.31796397875724	1.13468310536273	0.118954304662573	-0.0117865571370451	-0.797358810271147
h32	1.60840144776773	0.985831251742901	0.611463420582907	-0.0151715522507497	0.00505746615433162	4.00959219229460
h33	0.350803374133757	-0.403695071118726	-0.401333734597938	1.32383180338598	-0.0391352436416737	0.696649869247508
h34	0.934791307993708	0.853216214029097	0.980887325225082	1.05409009610170	-0.0535921540869912	2.00561679370393
h35	0.353360821927622	0.626714255118179	0.340413206872353	5.89349502921492	-0.300146477570000	1.07802869721107
h36	-3.09119223650703	-0.162238054538317	-0.0105326051843008	0.525677157864143	0.295132915894483	-3.48058627313065
h37	-0.0210159330752938	0.737071131121065	0.269097428413047	1.77540967886457	-0.0575216926933721	3.03062865217252
h38	0.996197256341004	-0.0194161049786822	0.0844974306213449	2.97224278065418	-0.149164921051050	2.12428554498078
h39	1.17537221519438	1.37832821498877	-1.22840324965565	1.67874693849263	-0.0692250599288325	2.77237921166054
h40	-3.96381720750098	0.558163786583869	-2.88984494477955	-0.130837915718820	0.00913108240948485	-2.06872909982273

Table 2. Trained ANN parameters (synaptic weights) between the hidden and output layers. The ANN architecture consists of 5 input neurons, 40 hidden neurons, 6 output neurons. A weight denoted as $w_{i,1}$ represents the weight between the 1st output neuron and the i -th hidden neuron.

Neuron in the hidden layer	Weights					
	$w_{i,1}$	$w_{i,2}$	$w_{i,3}$	$w_{i,4}$	$w_{i,5}$	$w_{i,6}$
<i>Bias, b_i</i>	0.989007137	-0.06244379	-2.972516784	0.232380994	-1.635372374	3.141808185
h1	0.155034785	0.274133277	0.21708887	-0.027264349	-0.398818654	0.935454044
h2	0.309623922	1.569535303	-2.129619592	-0.111814864	0.293892638	1.502795153
h3	-1.4511116929	-0.941199236	-0.503777369	0.646121119	1.646835588	1.874310605
h4	-0.443259295	-0.532519203	-0.018051105	0.188279852	0.557450937	1.531029851
h5	0.951307593	-0.485983715	0.074821591	-1.361114394	0.644135419	-0.958403903
h6	-1.664761596	-0.989479271	0.303215953	0.752267024	1.304388835	0.67692872
h7	0.755981179	0.218230377	0.881883103	-0.518817659	-0.895359227	-2.400877562
h8	0.699226743	0.041902036	-0.970145938	-0.473145285	0.316986185	2.549848574
h9	-0.003401601	0.094862238	-0.129185785	-0.008082449	0.044333533	0.143308161
h10	0.124435276	-1.27907097	-1.434487476	-1.235383138	2.717504173	2.635559135
h11	0.520152415	1.811903832	-2.032440725	-0.147539486	-0.075296537	0.853363977
h12	-0.143083245	-0.801778102	-0.047372229	-1.113959095	1.833771891	3.395171943
h13	1.003431576	1.747860567	0.678326875	0.512233868	-2.949693158	-4.718615098
h14	-2.064806937	-1.299888887	0.066481203	0.97110158	1.766242099	-2.863782219
h15	0.312573197	0.339342602	0.885818767	0.609430284	-1.733982695	-5.316739351

h16	-1.494762553	-0.803803828	-1.143118967	1.075286086	1.530432593	3.929082694
h17	-0.002643703	0.023791042	-0.116699266	-0.003800614	0.065925984	0.15702557
h18	-0.507971453	-0.183419336	1.175146508	0.392821969	-0.494904731	-3.142970041
h19	-0.001224123	0.354351019	-0.430753308	0.005004064	0.081405025	0.343798291
h20	0.979240217	1.084740542	-0.054910215	-0.401163096	-1.134479829	-2.266137497
h21	-0.001583243	-0.387316737	0.461903217	0.074831161	-0.169669136	-0.131330886
h22	0.020122915	-0.000315837	-0.030851937	-0.036927392	0.037241086	0.028648088
h23	0.009115725	0.168892885	-0.827462223	-0.048760968	0.453276264	1.753671304
h24	-1.438798497	-3.938421834	3.164768262	0.495728072	1.08173711	2.163234879
h25	1.842638017	0.86864023	0.680362336	-0.86273534	-1.908194995	-2.318408892
h26	-1.306166581	0.726324963	-0.221587061	1.892225679	-0.868304995	1.336267155
h27	0.154647443	-0.223220316	0.562628367	0.100771584	-0.510533642	-0.631485354
h28	0.274607566	0.138998217	0.558348592	-0.006227636	-0.703665909	-2.222433882
h29	1.094748599	0.563992917	-0.430933913	-0.678408869	-0.465509701	1.125414807
h30	-0.327475355	-0.109260633	-0.173327792	0.176456419	0.324141093	1.034981347
h31	0.002308604	0.17184041	-0.813946612	-0.038681184	0.440065463	1.680605355
h32	-0.40022954	-0.887255551	1.770149748	-2.675544576	2.8398605	2.953487795
h33	-1.502049379	0.372442486	-2.685098583	0.43652752	2.590160274	2.863413967
h34	0.411464885	0.165214357	0.976991119	0.046294501	-1.17988842	-3.73126985
h35	0.002798814	-0.445164594	0.63922157	-0.027918975	-0.138311716	-0.485920404
h36	0.458223455	0.099093337	0.292370717	-0.211239937	-0.496746948	-1.594649027
h37	2.308306362	2.123590811	0.348764239	-0.998999356	-2.664483875	-0.417570091
h38	-0.352237445	0.228236005	-0.003266739	0.561514959	-0.338496755	0.115695714
h39	-2.235941509	-0.936879932	0.163408333	1.238620578	1.444106475	-0.34253826
h40	-0.000873733	-0.172178368	0.875664586	0.023675097	-0.46140225	-1.79640328