



$$\hat{H}(p) = Y(p) / X(p) = [Y_1(p) \cdot X(p)^{-1}, Y_2(p) \cdot X(p)^{-1}, \dots, Y_k(p) \cdot X(p)^{-1}];$$

$$S_m = \{\hat{H}_{m1}(p), \hat{H}_{m2}(p), \dots, \hat{H}_{mN}(p)\}$$



$$S_1^{Tr}, S_2^{Tr}, \dots, S_M^{Tr};$$

$$CK_0 = [L_1, L_2, \dots, L_{N'}]$$

$$CK_1 = [L_2, L_3, \dots, L_{N'}, L_r], \text{ 其中 } r \text{ 限定为 } (r \neq 1 \sim N')$$

$$S_1^{Tr}, S_2^{Tr}, \dots, S_M^{Tr},$$





$$S_m^{Tr} = \left\{ \begin{array}{cccc} \hat{H}_{m1}(p), & \hat{H}_{m2}(p), & \cdots, & \hat{H}_{mN}(p) \\ m, & m, & \cdots, & m \end{array} \right\}.$$





$$\hat{H}(p) = Y(p) / X(p) = [Y_1(p) \cdot X(p)^{-1}, Y_2(p) \cdot X(p)^{-1}, \dots, Y_k(p) \cdot X(p)^{-1}];$$

$$S_m = \{\hat{H}_{m1}(p), \hat{H}_{m2}(p), \dots, \hat{H}_{mN}(p)\}$$



$$S_1^{Tr}, S_2^{Tr}, \dots, S_M^{Tr};$$

$$CK_0 = [L_1, L_2, \dots, L_{N'}]$$

$$CK_1 = [L_2, L_3, \dots, L_{N'}, L_r], \text{ 其中 } r \text{ 限定为 } (r \neq 1 \sim N')$$



$$S_1^{Tr}, S_2^{Tr}, \dots, S_M^{Tr},$$



$$S_m^{Tr} = \left\{ \begin{array}{cccc} \hat{H}_{m1}(p), & \hat{H}_{m2}(p), & \cdots, & \hat{H}_{mN}(p) \\ m, & m, & \cdots, & m \end{array} \right\}.$$





$$\hat{H}(p) = Y(p) / X(p) = [Y_1(p) \cdot X(p)^{-1}, Y_2(p) \cdot X(p)^{-1}, \dots, Y_8(p) \cdot X(p)^{-1}];$$

$$S_1 = \{\hat{H}_{11}(p), \hat{H}_{12}(p), \dots, \hat{H}_{1,1000}(p)\}$$





$$S_m = \{\hat{H}_{m1}(p), \hat{H}_{m2}(p), \dots, \hat{H}_{m1000}(p)\};$$



$$S_m^{Tr} = \left\{ \begin{array}{cccc} \hat{H}_{m_1}(p), & \hat{H}_{m_2}(p), & \cdots, & \hat{H}_{m_{1000}}(p) \\ m, & m, & \cdots, & m \end{array} \right\}$$

$CK_0 = [L_1, L_2, L_3]$   
 $CK_1 = [L_2, L_3, L_r]$ , 其中 $r$ 的限定为 $(r \neq 1 \sim 3)$  ;



边缘服务器与各终端根据规定选择统一的导频信号



终端设备在发送信号的数据包中按照设定规则插入已知的原始导频信号后，发送给边缘服务器



边缘服务器使用多天线接收数据包，并分离导频信号，计算信道矩阵的估计值



对终端设备进行多次数据采集和信道矩阵估计，得到终端设备的信道矩阵估计集



对于不同的已知终端设备，测得对应的信道矩阵估计集



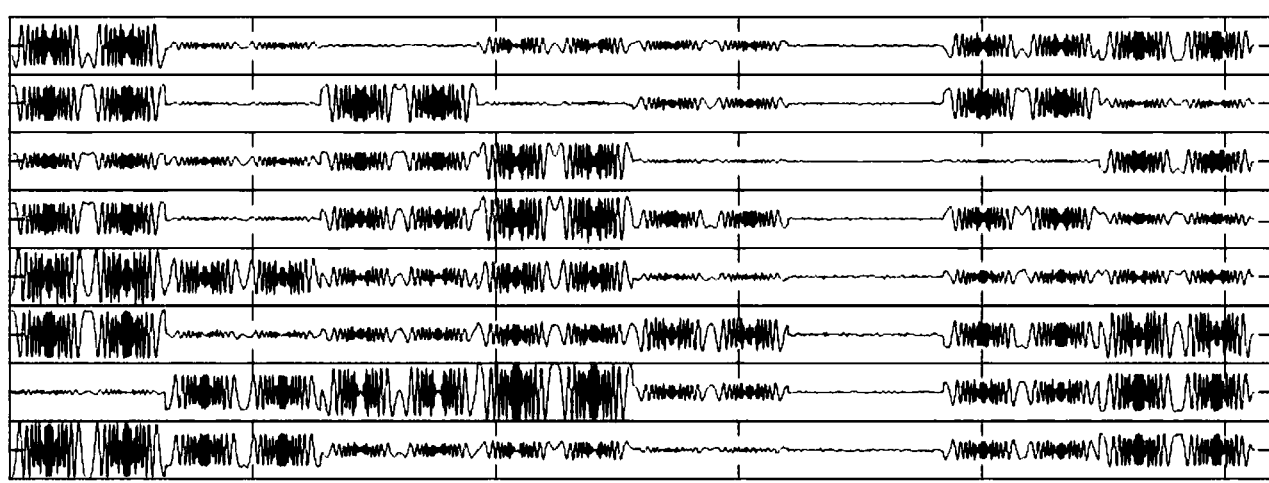
对于待验证的终端设备，测得对应的信道矩阵估计值



建立卷积核和卷积核移动规则，据此对卷积神经网络进行训练



使用训练好的卷积神经网络分类模型对待验证的终端设备的信道矩阵进行分类



	Re_1st	Re_2nd	Re_3rd	Re_4th	Re_5th	Re_6th	Re_7th	Re_8th
1	0.002243161	0.002823544	0.000303374	0.000523245	-0.00403534	0.002258352	0.000700036	-0.004460545
2	0.002307431	0.002955106	0.000323722	0.000705093	-0.004349526	0.002465157	0.000480787	-0.004366147
3	0.001273541	0.004060528	0.000915556	0.001228135	-0.004107182	0.00266806	0.000607564	-0.004835507
4	-0.000361993	0.00477283	0.001383605	0.001770111	-0.004053356	0.003196796	0.000454671	-0.004844652
5	-0.002773163	0.005901842	0.00222933	0.002309696	-0.003022123	0.003493159	0.000404719	-0.004699434
6	-0.005110863	0.005743198	0.00263867	0.002309255	-0.001675077	0.003355374	0.000121894	-0.003449573
7	-0.006797713	0.00471018	0.002850412	0.002204033	0.000692973	0.00251773	-0.000217618	-0.001420264
8	-0.005974428	0.001549882	0.001828646	0.001097643	0.00311906	0.000364966	-0.000450915	0.001514296
9	-0.002186229	-0.002605029	-0.000137911	-0.000524633	0.004245803	-0.001985768	-0.000558256	0.004203959
10	-0.001147268	-0.005637542	-0.002174322	-0.002226934	0.003003088	-0.003714507	-0.000183823	0.004322859
11	0.006835499	-0.004966875	-0.002884786	-0.0022919	-0.00076327	-0.002497148	0.000183926	0.001464873
12	0.00433996	0.001068619	-0.000708075	-0.000220741	-0.003856778	0.001018134	0.000693309	-0.003354479
13	-0.002628059	0.005943704	0.002275751	0.00204064	-0.003123839	0.003574025	0.000531667	-0.004573539
14	-0.006740419	0.003721705	0.002546342	0.00203916	0.00153076	0.001916144	-0.000311903	-0.000400224
15	-0.001147268	-0.003707821	-0.000669821	-0.000969046	0.004174153	-0.002803634	-0.000517287	0.004211128
16	0.006756818	-0.005486718	-0.002935981	-0.002288886	-0.000116934	-0.002962424	-5.27326E-05	0.002044658
17	0.002544321	0.00267537	0.000213583	0.000767101	-0.004145499	0.002223949	0.000481576	-0.004208998
18	-0.006618566	0.005258531	0.002959204	0.002432154	-1.49616E-05	0.002734051	-8.34111E-05	-0.00217475
19	-0.001151666	-0.003812375	-0.000775887	-0.001168468	0.003958374	-0.00258326	-0.000825078	0.004551967
20	0.006815248	-0.00353856	-0.002608749	-0.00170526	-0.001574837	-0.001798467	0.000178	0.000235667
21	-0.002728401	0.005945876	0.002152475	0.002147564	-0.003234294	0.003468886	0.000519585	-0.004542953
22	-0.004390739	-0.00091671	0.000772493	0.000137465	0.003651382	-0.000906128	-0.000625436	0.003302108
23	0.006758853	-0.004682233	-0.002751524	-0.002187305	-0.00057705	-0.002519428	0.000118034	0.001624555
24	-0.002965616	0.006030073	0.002391655	0.002184053	-0.003055708	0.003428405	0.00048194	-0.004513975
25	-0.002319568	-0.00280398	-0.000161016	-0.000589397	0.004077463	-0.002254001	-0.000650429	0.004082211
26	0.006340193	-0.001566373	-0.001873549	-0.001037823	-0.002927193	-0.000287584	0.00042542	-0.001696473
27	-0.006784445	0.005026399	0.002903407	0.002372704	0.000723201	0.002618277	-2.85302E-05	-0.001651111
28	0.005143934	-0.005991315	-0.002834903	-0.002621447	0.001530926	-0.003557793	-0.000112208	0.003606566
29	-0.002647799	0.005843475	0.002191961	0.002053979	-0.003342528	0.003848779	0.000314811	-0.004366164
30	0.000256778	-0.004673714	-0.001361686	-0.001548535	0.004139698	-0.003163567	-0.000413522	0.004708719
31	0.001353205	0.003725933	0.000846036	0.00096598	-0.003886757	0.002504258	0.000736716	-0.004610602
32	-0.002262258	-0.002961938	-0.000283973	-0.000693722	0.004312641	-0.002390428	-0.000533307	0.004223472
33	0.002319311	0.002312554	-0.000109426	0.000610998	-0.004376284	0.002015721	0.00039795	-0.004143368
34	-0.002254188	-0.002920908	-0.000262334	-0.000647889	0.00421688	-0.002254299	-0.00076688	0.004204116
35	0.001055528	0.003692778	0.00076674	0.001040291	-0.004044896	0.002422156	0.000615562	-0.004446063
36	0.000581265	-0.00446071	-0.001239334	-0.001689474	0.004002332	-0.003376781	-0.000333796	0.004801983
37	-0.002398666	0.005743903	0.001963526	0.002195095	-0.00340218	0.003743647	0.000446205	-0.004617598
38	0.00516097	-0.006143726	-0.002885395	-0.00247859	0.001553325	-0.003302801	-0.00027551	0.003568014
39	-0.007004761	0.005005557	0.003020475	0.002265581	0.000669003	0.00268771	-3.54864E-05	-0.0014393





边缘服务器与各终端根据规定选择统一的导频信号



终端设备在发送信号的数据包中按照设定规则插入已知的原始导频信号后，发送给边缘服务器



边缘服务器使用多天线接收数据包，并分离导频信号，计算信道矩阵的估计值



对终端设备进行多次数据采集和信道矩阵估计，得到终端设备的信道矩阵估计集



对于不同的已知终端设备，测得对应的信道矩阵估计集



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使用训练好的卷积神经网络分类模型对待验证的终端设备的信道矩阵进行分类