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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. Filed Electronically

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Additional inventors are being named on the <u>0</u> separately numbered sheets attached hereto.		
TITLE OF THE INVENTION (500 characters max):		
CODEBOOK SUBSET RESTRICTION FOR 2-DIMENSIONAL ADVANCED ANTENNA SYSTEMS		
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ENCLOSED APPLICATION PARTS (check all that apply)		
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76		
<input type="checkbox"/> Drawing(s) <i>Number of Sheets</i> _____		
<input checked="" type="checkbox"/> Specification (e.g. description of the invention) <i>Number of Pages</i> <u>41</u>		
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Fees Due: Filing Fee of \$220 (\$110 for small entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is \$270 (\$135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).		
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<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.		
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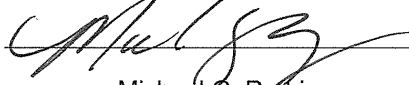
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SIGNATURE  Date July 12, 2012

TYPED or PRINTED NAME Michael G. Rodriguez REGISTRATION NO. 60,236
(if appropriate)

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PROVISIONAL PATENT

CODEBOOK SUBSET RESTRICTION FOR 2-DIMENSIONAL ADVANCED ANTENNA
SYSTEMS

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CODEBOOK SUBSET RESTRICTION FOR 2-DIMENSIONAL ADVANCED ANTENNA
SYSTEMS

PROVISIONAL PATENT APPLICATION

[0001] The following documents and standards descriptions are hereby incorporated into the present disclosure as if fully set forth herein:

[0002] REF1 -3GPP TS 36.211 v10.1.0, "E-UTRA, Physical channels and modulation."

[0003] REF2 - 3GPP TS 36.212 v10.1.0, "E-UTRA, Multiplexing and Channel coding."

[0004] REF3 - 3GPP TS 36.213 v10.1.0, "E-UTRA, Physical Layer Procedures."

[0005] This disclosure considers codebook designs and associated feedback for multi-user (MU) MIMO transmissions from transmission points equipped with 2-dimensional (2D) active antenna array depicted in Figure 1. Here, transmission points (TPs) are network nodes can transmit downlink signals and receive uplink signals in a cellular network, examples of which include base stations, NodeBs, enhanced NodeBs (eNBs) remote radio heads (RRHs), etc. On the other hand, an entity controlling at least one TP is called the controller, the network or eNB in this disclosure. Each active

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antenna array may have separate base band, which could dynamically control the antenna weights in frequency selective manner.

[0006] The transmission point depicted in Figure 1 has N ($=N_H \times N_V$) 2D active antenna elements, and the N antenna elements are placed in 2D grid of $N_H \times N_V$. The horizontal spacing between any two closest antenna elements is denoted by d_H , and the vertical spacing between any two closest antenna elements is denoted by d_V .

[0007] Figure 2 defines the azimuth and elevation angles to UE k from the TP equipped with 2D antenna array. In the example placement shown in the figure, antenna elements are placed in a rectangle on XZ plane in an orthogonal XYZ coordinate system. The origin of the coordinate system is placed at the center of the rectangle. The azimuth (horizontal) angle θ_k for UE k is defined as the angle between Y axis and the projection vector of a straight line between the TP and UE k to the XY plane. On the other hand, the elevation (vertical) angle ϕ_k is defined as the angle between Y axis and the projection vector of the straight line to the YZ plane.

[0008] In cellular networks, the network utilizes UEs' channel state information (CSI) to schedule time-frequency resources, to select precoders and modulation and coding schemes (MCS) for each

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