This paper presents a general approach for coherency detection in bulk power systems using the projection pursuit (PP) theory. Supported by the concept of center of inertia (COI) in power systems, the PP theory is employed to model the wide-area coherency detection as an optimization problem. In the proposed method, the optimal projection direction in high dimensional orthogonal space is explored in order to detect the coherent groups via the data from synchronous phasor measurement units (PMUs). Two quantitative indices constructed with projection assessment index (PI), the objective of the optimization model, are then defined in order to determine the critical coherent group and the dominant coherent groups. The coherency detection criterion and the implementation framework for the proposed approach are also presented. Simulation data from the 16-machine 68-bus test system and China Southern power Grid (CSG), along with actual field-measurement data retrieved from WAMS database in the CSG, are employed to demonstrate the effectiveness and applicability of the proposed algorithm under different disturbances. It is shown that the proposed methodology successfully detects the dominant coherent groups of generators and buses in bulk power system via the wide-area field-measurement data.