**3D Space Truss Structural Analysis System** built with **React (frontend)** and **Django + MySQL (backend)**. Here's what it does:

**🏗️ Core Functionality:**

1. **Node & Element Input:**
   * You define 3D nodes (x, y, z).
   * You connect nodes into truss elements with given area (A) and Young’s modulus (E).
2. **Supports & Loads:**
   * Supports are applied as constraints (restrained in x, y, z).
   * Loads are applied to nodes (Fx, Fy, Fz).
3. **3D Visualization:**
   * Nodes, elements, supports, and loads are rendered in a Three.js-powered 3D scene.
4. **Matrix Structural Analysis (MSA):**
   * Direction cosines, transformation matrices, local stiffness matrices, and global stiffness matrix [K] are computed.
   * Global load vector [P] is assembled.
   * Boundary conditions are applied to get [K\_modified] and [P\_modified].
   * System is solved for displacements [d].
   * Reactions and internal axial forces are computed.
5. **Results Displayed in Tables:**
   * You can view:
     + Direction cosines
     + Element stiffness matrices
     + Global stiffness matrix [K]
     + DOF mapping
     + Modified matrices
     + Displacement vector
     + Reaction forces
     + Internal axial forces
6. **Reset Feature:**
   * A single button clears all MySQL tables (nodes, elements, loads, supports, stiffness matrix) for a fresh analysis.

**🔧 Stack:**

* **Frontend:** React + TypeScript + TailwindCSS + Three.js
* **Backend:** Django REST Framework
* **Database:** MySQL

Future:

| **Feature** | **Description** |
| --- | --- |
| 🔄 **Modal & Dynamic Analysis** | Add natural frequency & mode shape calculation. Use eigenvalue analysis on [K] and mass matrix [M]. |
| 📐 **Buckling Analysis** | Integrate eigenvalue buckling for critical loads. |
| 🔥 **Nonlinear Geometry** | Include second-order effects (P-Δ). Requires iterative solution, not just linear algebra. |
| 🧮 **Truss Optimization** | Minimize total weight or max displacement with constraints using optimization libraries. |
| 📊 **Report Export** | Add PDF/Excel export for all results. |
| 🧱 **Material Database** | Let user select materials (Steel, Aluminum, etc.) with E, density, yield strength. |