

Performance of induction generator with natural gas utilization with grid interconnection

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Abstract

Incorporation of micro sources in micro grid systems is expanding in the present innovation. The flammable gas power age through conventional micro turbines may not appropriately collaborate with the electrical system. In this paper to explain the above issue, single shaft enhanced micro turbine and split shaft enhanced micro turbine are presented and investigated. With these micro turbine models gaseous petrol and electrical system is additionally composed with dynamic task of the machine. For outline of micro turbine halfway differential conditions are prompted in the subsystems of the model. Exchange capacities are given as for the gadget associated in the turbine. The turbine controller is adjusted with a fluffy control for powerful and down to earth utilization of the micro turbine with change of esteems as for time. The micro turbine is mechanically coupled to induction generator with steady speed task, and the dynamic attributes of the machine are watched. The total examination is completed in MATLAB Simulink programming with every single graphical portrayal and reports.

1 Introduction

The idea of microgrid has offered customers with expanded dependability and lessening in absolute energy misfortunes, and has turned into a promising option for customary power distribution system [1], [2]. One zone of concentrate for the association of a microgrid to the distribution grid is the effect of power quality (PQ) issues on the general power system execution. These PQ issues incorporate voltage and recurrence deviations in the grid voltage and music in the grid voltage and load currents. To overcome the previously mentioned PQ issues, a few power-molding types of gear, for example, dynamic lters [3], [4], uninterruptible power supplies [5], [6], dynamic voltage restorers [7], [8], and unied PQ conditioners [9] are normally utilized by shoppers to ensure their loads and systems against PQ unsettling influences in the distribution arrange. Nonetheless, these gadgets are typically introduced at the shopper sides and the PQ issues that they are skilled to deal with are normally restricted.

Since a huge part of power is created by gas-powered units in the US, to improve the activity of crossover flammable gas and power system (HGES) draws increasingly concern. A point by point examination of the collaborations between the flammable gas arrange and the electric system is introduced in [7] [12], including the effect of gaseous petrol value uctuations [7] and pipeline shortcomings [8] on the power system security, unit duty [9] and chance evaluation [10], [11]. Brazilian specialists dissected the cooperation between the flammable gas foundation and the hydropower system, considering just an unfaltering state gaseous petrol arrange and a DC power ow display [12]. A multi-day and age improvement strategy was proposed to lessen working cost, in light of the Great Britain gas and power arrange [13]. The associations among energy systems of a couple of units were an-alyzed in view of energy center in [14]. As delineated in [12], it isn't precise to break down the HGES utilizing just enduring state display. Nonetheless, the distributed investigations are for the most part centered around unfaltering state or semi relentless states. Hardly any talks have been given to HGES's dynamic cooperations.

The gaseous petrol segment likewise smooths out the inconsistency issues characteristic in wind energy. At the point when it's

not blowing, petroleum gas will produce steam to turn the turbines.

The sun powered warm innovation originates from a little organization called eSolar, which utilizes a great many little, pre-created mirrors called heliostats to reflect daylight toward a collector, which utilizes the warmth to produce steam. Calculations consequently track and center the sun’s beams, as per a news discharge from GE. The gas turbine is another outline GE disclosed it a month ago and the organization says the plant will be 69 percent effective, more than twofold the effectiveness rate of other gaseous petrol power plants. The innovation is intended for nations that utilization 50 hertz power, Technology Review calls attention to the US utilizes 60 hertz, so it’s uncertain whether this could take a shot at our dirt.

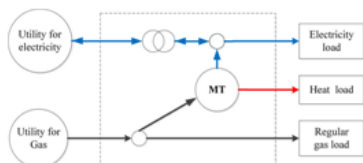


Fig. 1: Hybrid Natural gas utilization diagram

Hybrids are regularly separated into the subtypes of either arrangement or parallel, which alludes to the manner by which the motor supplies power to the drive system. In the arrangement hybrid, a warmth motor powers a generator which charges the battery or supplies power straightforwardly to the drive circuit and along these lines decreases request on the battery. Town Car (accessible in a DIY designs bundle on this site) is an arrangement hybrid. The XR3 Hybrid, additionally accessible on this site, is a ground-associated parallel hybrid. In a parallel hybrid, the warmth motor conveys mechanical power straightforwardly to the drive prepare, and the generator is wiped out. With this write, the battery-electric system or the warmth motor might be utilized to move the vehicle, or they might be utilized at the same time for most extreme power. The parallel hybrid is more effective than the arrangement hybrid. The effectiveness advantage originates from the way that parallel hybrids convey warmth motor power (mechanical power) straightforwardly to the power prepare, as opposed to changing over the power into power.

Misfortunes happen at whatever point power is changed over starting with one shape then onto the next. In the arrangement hybrid, a warmth motor runs a generator to create power. This change (from mechanical to electrical power) brings about lost around 20 percent. Power might be conveyed to a battery or to an engine to give rationale power. On the off chance that it is conveyed to an engine, the engine changes over electrical energy into mechanical power, yet the transformation brings about lost around 20 percent. In the event that electrical energy is conveyed to a battery, an extra 20 to 30 percent of the energy will be lost in the change procedure (putting the surge into the battery [3] and after that taking it out once more). Since the warmth motor produces mechanical power in any case, it is more proficient to give it something to do in its local shape as opposed to making a twofold transformation - starting with one frame then onto the next shape and after that back to its unique frame. In any case, choices about when to change over and the amount to change over are building choices that are made inside the setting of the aggregate plan of the system.

The primary hybrids presented were "gentle hybrids". With a gentle hybrid [5] a scaled down warmth motor is introduced to give the essential intention power. The electric power system is designed to expand the shortage in torque of the warmth motor amid times of speeding up. At cruising speeds the warmth motor powers a generator [7] (regularly the torque-help engine is electronically exchanged into an age mode) to renew the electrical energy that was utilized for quickening. These sorts of hybrids are not intended to keep running on battery power alone. So the battery pack is little in contrast with that of an ordinary BEV maybe enough energy stores to drive for a few squares.

2 SIMULINK MODELING OF SIMT and SPMT

Two regular sorts of MTs are accessible in light of the places of the turbine and generator. They are the Rowen's model (SIMT system) portrayed in [9] and a prime mover demonstrate (SPMT system) depicted in [7]. As appeared in the dashed box in Fig. 2 and Fig. 3, it can be discovered that the valve and fuel supply

systems in the two MT models are considered as first arrange inertial connections. These models disregard progression of flammable gas system outside the MT and consider the petroleum gas arrange as a consistent weight gas supply system. Be that as it may, there exist two issues in the conventional models. From one perspective, MT yield power direction will cause weight variety to the gas organize, however customary MT models just give gas volume devoured by the MT, which isn't a suitable limit condition for flammable gas arrange recreation [3]. Then again, petroleum gas arrange weight can be influenced by the gas well or different gas loads, which will likewise influence the MT yield. Customary MT models don't have a thing that is associated with the petroleum gas arrange. Along these lines, two enhanced MT models are proposed to rectify the collaboration between the two systems. In the enhanced models, a valve controller is included into the first fuel supply system. The valve controller controls the valve opening to modify the gas weight of the MT, which will change the gas flow infused into the MT.

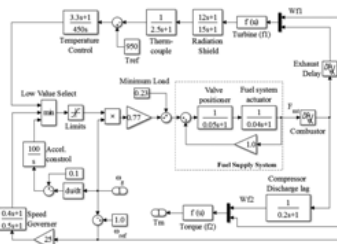


Fig. 2: SPMT simulink modeling

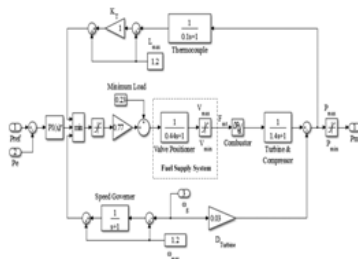


Fig. 3: SIMT Simulink modeling

3 INTEGRATION OF INDUCTION GENERATOR WITH SIMPT AND SPMT

Induction machine is generally of two types

- 1) Squirrel cage rotor Induction machine
- 2) Wound rotor Induction machine

In any case, the stator is same in both the machines just the rotor development is unique. The stator is a static center with three stage twisting associated in either wave winding or lap winding association. The rotor is a dynamic component with notable shafts which are injured with copper wires. A basic outline of the machine can be found in the fig. 4 underneath.

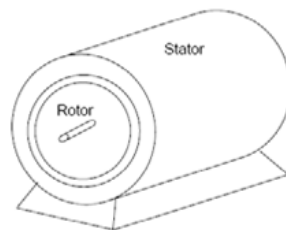


Fig. 4: Induction machine

It can be utilized for any turbine (wind, diesel, and steam, hydro) where the working attributes are like any wellspring of age. Notwithstanding, the yield of the Induction machine is a three stage AC with a recurrence, the adjustment in the turbine speed changes [10] the recurrence of the AC yield. The stator center includes openings for the windings to be injured, with the quantity of spaces are basic products of six. As each stage require two openings for the winding where the quantity of spaces for three stages will be six. For instance considering 12 openings in the stator center and a solitary stage winding chart can be seen underneath in fig. 5.

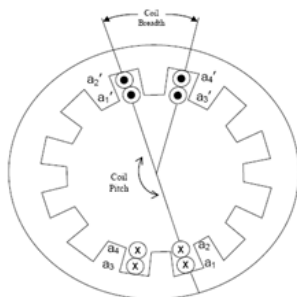


Fig. 5: Single phase winding of the stator

Each turn is twisted with correct inverse post, which can be seen in the figure above where, into the paper is 'X' and out of the paper is '•'. With alter in the course of the loop from the upper piece of the casing and lower some portion of the casing the bearing of current likewise changes, creating exchanging yield from the stage. The precise separation between the nearby shafts is characterized as loop broadness and the rakish separation between the contrary posts is characterized as curl pitch. The other eight spaces are injured with the other two stages with electrical stage move of 1200 [13] disseminating four shafts to each stage. Diminishing the entanglement of the winding graph, two openings are viewed as together as a solitary space which speaks to each stage with two spaces instead of four spaces. The altered diagrammatic portrayal of the single space thought can be seen underneath in fig. 6.

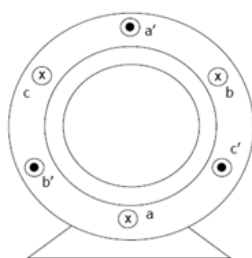


Fig. 6: Simplified winding slots in stator

Assuming that the three phases are a b and c the three electrically isolated windings are done with a mechanical angle difference

of 120° to each other that is the slot angle difference between a b c is maintained at 120° to each other.

The synchronous speed of the machine with a given frequency and number of poles on the stator is given as

$N_s = (120 * f) / P$ where, f = fundamental frequency of the sinusoidal waveform;

P = number of poles in the stator;

Angular speed of the machine rotor can be denoted as

$\omega_r = (2 * \pi * N_r) / 60$ where, N_r = Speed of the rotor in rpm (revolutions per minute);

The slip of the machine is given as

$S = (N_s - N_r) / N_s$ where, N_s = synchronous speed; N_r = rotor rotational speed;

4 SIMULINK MODELING OF TEST SYSTEMS

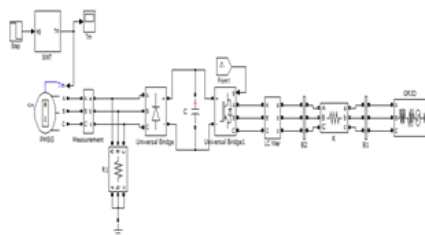


Fig. 7: SIMT with PMSG integration

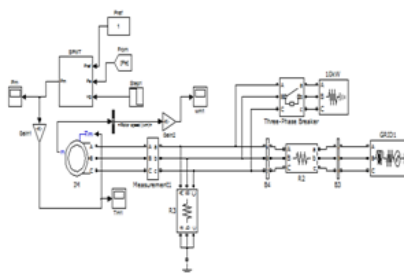


Fig. 8: SPMT with squirrel cage Induction machine integration

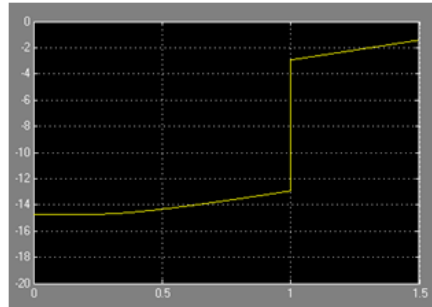


Fig. 9: Torque variation of SIMT with change in natural gas

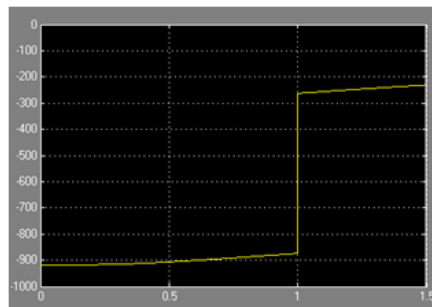


Fig. 10: Torque variation of SPMT with change in natural gas

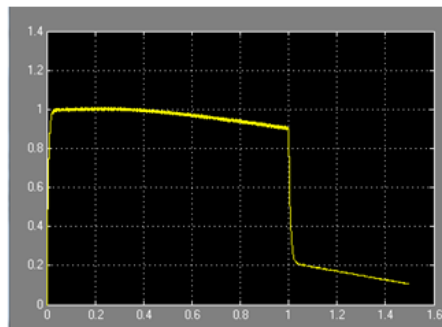


Fig. 11: Speed variation of SIMT generator with change in natural gas

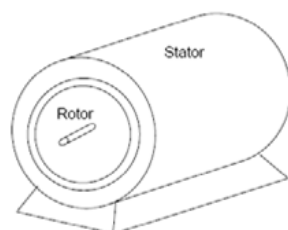


Fig. 12: Speed variation of SPMT generator with change in natural gas

5 CONCLUSION

With the above consequences of the both test systems SPMT is thought to be more steady and solid for any adjustments in flammable gas input. With the help of Induction machine the speed of the rotor is more steady with change in the torque of the turbine. The correlations of both rotor speeds are appeared in the outcomes settling the ideal task of Split shaft Micro Turbine.

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